THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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THE SUCTION GAS PROBLEM.

WE print elsewhere in this paper an abstract of a paper embodying many points of distinct interest, which has been read by Mr. W. A. Tookey before the British Association. Mr. Tookey has for a long time been associated in a very prominent manner with the development of the suction gas plant, and his moderation in statement and claim must be the subject of our congratulation.

Probably one of the most valuable features of his paper is the evident feeling that it is useless to base his arguments concerning the relative value of steam or gas engines upon so-called test results; what is required is the actual day-by-day experience of the engineer who has "lived with" the plant. Formerly we were far too often subject to the clamour of suction gas plant manufacturers, who sought to make speedy converts by conducting "tests" under abnormal conditions, and thus obtaining astonishing results which would not be sustained in practical working. That a more systematic, careful and scientific method of research has supervened is a matter for congratulation.

Another point which is of great value in this connection is the demonstration of the fact that the suction gas producer plant is not an eliminator of skilled labour. The author admits, in a very fair and open manner, that maintenance and repairs are necessary, and we draw the inference from his paper that they are on about the same scale of frequency and magnitude as those in a similarly sized steam plant. Possibly Mr. Tookey will say they are a little less; but this does not affect the main point in our argument. We frankly do not care to accept, without a great deal of reserve, any claim for any plant, be it electrical or mechanical, that it will without attendance, maintenance or repair, do work which formerly required the employment of technical assistance. On the one hand, we are sorry for the men thrown out of employment, if the claim is true; on the other, our experience of invention and discovery is that in ninety-nine cases out of a hundred the technical craftsman is dismissed at one end of the scale to be called in at the other to put matters right again. In saying this, we know we are open to challenge; until we are converted, however, we believe that there is a permanent place for the technician not only in the design, but in the operation of power plant.

For this reason, and not through any animosity to the suction gas plant as a means of power production, we have felt it our duty in the past to protest against statements which we felt to be exaggerated, if not untrue, as to the possibility of eliminating skilled labour by the installation of these plants. We felt that such an impression, if allowed to get abroad among manufacturers, would lead them to disappointment and loss, and we are glad to note the care and completeness with which Mr. Tookey has dealt with the actual ascertained costs of running and attendance.

We do not, however, wish to traverse too closely the

ground which Mr. Tookey has made his own; we are sure that our readers will prefer to examine for themselves the operating results which have been obtained and to compare them with cases known to themselves. Obviously, the author has only been able to draw upon a limited number of installations for his facts, and it is possible that some of our readers may be acquainted with other installations whose working figures are available for confirmation or otherwise of his figures. We shall gladly welcome any communications upon the subject in our "Correspondence" columns provided that useful data and not merely opinions are given. The matter which we wish to discuss here is one to which the paper merely acts as an introduction. It is the closing portion that is the most suggestive, as it indicates a position to which all electrical engineers should be alive.

We have the contrast betwen the semi-portable steam plant, the Diesel engine, and the suction gas plant. The first represents the effort to combine the advantages of the central steam-driven station in a private plant. The second is probably the best method known of utilising fuel oil; the third, commencing operations on anthracite or coke, is now rapidly finding a wide field of application in the utilisation of factory waste. How does the steam-driven central-station power plant stand with relation to each of these three? As regards the first, it is a clear-cut comparison of price of power generated locally or transmitted, inasmuch as the means of production are the same. We want data to show for the small superheated-steam plant the actual operating costs, in the same precise way as Mr. Tookey has demonstrated those of the suction-gas plant. Except where distances of transmission are very long, it seems to us that the advantages of large power units and a good diversity factor will give the preference to the centralised plant.

As regards the second type of power producer, the Diesel engine has opened our eyes to the commercial availability of oil fuel both on land and at sea; and, granted that we can at all times secure an adequate supply of oil fuel, there is no doubt that new conditions of competition have arisen which were unknown to the steam engineers of 10 years ago. Many of the smaller electric generating stations are now equipped with oil engines of this type, and are operating with very satisfactory results. It must not be forgotten, however, that, in Great Britain at any rate, the supply of oil fuel depends on uninterrupted transport in even greater degree than that of coal. We need not labour this point; the recent strikes of railwaymen and dockers bear their own warning to all thinking men. If fuel oil becomes an important factor in our industrial life, then adequate and ample oil storage is of as great importance as grain storage to our national prosperity.

The true aspect of the third type—or, rather, that which the third type foreshadows—has not yet been fully realised in this country, although we are beginning to be aroused. The keynote of future industrial progress will be the elimination of waste, and of this the throttle-governed high-speed suction gas plant fed by works' refuse, to which Mr. Tookey refers, is one of the portents. It is marvellous that the twentieth century should have dawned before engineers should have utilised the waste heat from coke ovens in Durham to drive steam-operated electric stations. Is it a rash prophecy to say that shortly, with the advent of the large gas-power engine, we shall see the elimination of the intermediate steam links in such plants and the direct drive of large generators by gas engines fed by the gases from the retorts? Such work is already done on the Continent. Even where an electric supply over hundreds of square miles of countryside is not so feasible as it is in Northumberland and Durham, is there not a field for enterprising municipal engineers of such industrial areas as, say, Sheffield or Birmingham, to enter into contracts with manufacturers to utilise their waste heat and waste products in gas-driven (or, if necessary, steam-driven) plants feeding on to the municipal mains, and thus making use of the diversity factor of the operations of the whole city to use up every bit of power generated? This would be better than is the case at present, of letting all this power and material go to waste, and better even than a manufacturer putting up his own little power plant and electric works distribution system as the only alternative to taking the city supply obtained from coal fed boilers. The economic advantages of the waste heat plants have already been demonstrated on a large scale; why is the application not more generally made?

We suggest, as a basis for discussion and possible action, that the present competition between centralised and private power plants is put on a false basis having regard to the changed conditions of which we are now aware. We suggest co-operation, not competition, between the central power supply authority and the private manufacturer, even on a small scale, who has waste that he does not know what to do with. We venture to think that in many instances the energies of those who, like Mr. Tookey, are interested in the industrial utilisation of waste, could be profitably united with those of the engineers who have problems of general supply of electricity under their consideration.

The L.C.C. and Wood Casing.

According to the daily Press, on the strength of an allegation to the effect that several of the recent big fires in London have been caused by badly insulated electric wires—on what authority we do not know—the Building Committee of the L.C.C. is considering the advisability of promulgating a decree that all hotels and lodging houses wired in wood casing shall be rewired in steel tubing. It is notorious that the arbitrary and vexatious building regulations of the County Council have already driven many works and factories out of London to places where the local authorities recognise that industry should be encouraged not repressed; the hotels and lodging houses cannot escape in this way from the tyrrany of "self-government," and must, therefore, prepare for trouble, if the threatened edict is issued, and can be legally enforced.

There are two aspects from which the matter may be viewed. Our concern is mainly with the technical aspect, and we say without hesitation that so drastic a proposal is absolutely unjustified by the facts. Wood casing is by no means the culprit that it appears to be considered; there are numerous buildings of every size and description which were wired 20 or more years ago in wood casing, and in which the installation is to-day in irreproachable condition, while any contractor or consulting engineer can point to cases where steel tubing put in but a few years ago has failed disastrously. It is not a question of wood casing or steel conduit, but of good or bad workmanship. The use of wood casing is expressly sanctioned by the latest edition (April, 1911) of the Wiring Rules of the Institution of Electrical Engineers, and therefore by some 50 insurance companies and innumerable electricity supply authorities which have accepted these rules as standard practice; and a large portion of the Institution building on the Embankment is still efficiently wired in the original wood casing that was put in some 23 years ago. We need go no further for authority, nor should the L.C.C.—the I.E.E. wiring rules embody the knowledge and experience of the leading experts in the electrical world, and should suffice even for that autocratic assembly.

And this brings us to the second aspect of the question—the liberty of the British citizen. It is a singular but unquestionable fact that the present is an age of continual encroachment upon the liberty of action of the individual, particularly in the direction of administrative restrictions upon industry framed ostensibly for the public benefit, but eventually reacting adversely upon those intended to profit, as we have shown in previous articles. So long as a man conducts his business honestly, without detriment to his fellowmen, and without infraction of the amenities of society, he

is entitled to exemption from meddlesome and pettifogging by-laws such as that in question. The cost of the expensive alterations that would be necessitated by its operation must fall eventually upon the shoulders of the public, who have made no demand for its adoption, and would be not a whit the better off if it were put in force. Both technically and economically the suggested by-law is unnecessary and objectionable, and we trust that wiser counsels will ensure its rejection.

Noisy Motorists.

Repeated protests in the Press have drawn the attention of the responsible authorities to the growing nuisance constituted by the abuse of warning signals by the drivers of motor vehicles, and the Commissioner of Police of the Metropolis has issued a circular calling upon the owners and drivers of motor vehicles to do what they can to reduce the annoyance caused, especially at night, by the excessive and nerve-racking use of the horn or of unsuitable devices. Unless this is done voluntarily, the Commissioner points out, there is certain to be an insistent demand for repressive legislation.

We cannot too heartily endorse the views of the Commissioner. No one resident within the metropolitan area can have failed to realise that some motorists have lately adopted devices which emit the weirdest and most unearthly cacophonies—howls and shrieks as of wild beasts in paroxysms of rage—which are not only distracting to the ear, but are also obviously intended to clear the way far ahead of the vehicles. Now, the latter object is one with which we have no sympathy. We have no objection to the maintenance of a reasonably high speed on roads where the conditions of traffic admit of it, but where there is much traffic, and in all densely populated centres, all motorists who profess to have any regard for the comfort and rights of their fellow citizens—that is to say, all who possess the essential qualification of a gentleman—will moderate their speed to a value which renders the use of frightful and terrifying noises superfluous.

The proper function of the signal is not to drive other users of the public way to the roadside, but simply to give warning of the approach of a swifter vehicle, and to prevent accidents at crossings. Some hold, not without reason, that the total prohibition of such signals, by compelling drivers to exercise greater caution, would be a salutary ordinance. We do not go so far as that, but we cordially agree that the increasing volume of hideous noise due to motor-'buses, motor-cycles, and the instruments of torture worked by the exhaust of motor-cars, is rendering life in London more and more intolerable, and that drastic steps should be taken to abolish the nuisance.

Labour Unrest and the Trades Disputes Act.

The lawyer who ponders over the recent trouble in the railway world will naturally turn his attention to the Acts of Parliament which are intended to define and limit the powers of the Trade Unions. But he need not make any very extended research. There is no necessity for him to go back earlier than 1906. Had it not been for the measure which was passed in that year it is doubtful whether the recent strike of railway employés could have reached such gigantic proportions. Reducing it to its elements, this strike was the result of nothing but an agreement amongst workmen to break their contracts of employment. It was such an act which gave rise to the Taff Vale Railway case; which mulcted a Trade Union in heavy damages, and which gave rise to the political agitation which culminated in the Trades Disputes Act. Possessing that "charter of liberty," the trade unionists are now in a position to agree to break their contracts, and yet remain outside the law of conspiracy. That law restrains both the doing of a lawful act by unlawful means, and the doing of an unlawful act by lawful means—provided the parties are not concerned in a trade dispute. The Executive Council of the Amalgamated Society may recommend their members to leave work without notice, and yet the Union funds cannot be made liable for any of the damage thereby occasioned.

Another anachronism of the law relating to Trade Unions which is brought into relief by recent events is the legalisation of peaceful picketing. It is, of course, as we have already said, a contradiction in terms. In theory it is well enough; but in practice it is the more violent among the pickets who prescribe the policy and methods of persuasion which are to be adopted. It is to be hoped that some day a Government will come into being which is ready and willing so to amend the law relating to Trade Unions that the common law of conspiracy shall apply to trade disputes, and that picketing of all kinds shall be put an end to.

Electrical Schemes in Constantinople.

Some further particulars have been published in the Continental newspapers regarding the electrical schemes in Constantinople, to which reference was briefly made in our last issue, and which aim at the combination of the interests of the proposed electricity works with those of the local tramways. As is known, the concession for the electricity works was granted to Ganz & Co., who is said to have formed a Turkish company for the purpose in association with the group of the Deutsche Bank, although previous announcements have associated Belgian and French interests with the scheme. In the case of the Constantinople tramways, the concession for the conversion to electric traction was given to the tramway company itself, whose shares are largely held by the Ottoman Union of Zurich, which recently announced its intention of disposing of them to a Belgian group. It is now sought to combine these two undertakings, in the first place, by the establishment of a Constantinople syndicate (Corsortium de Constantinople), in which the lead will be taken by the Société Financière de Transports et Entreprises Industrielles, of Brussels, which is understood to be closely associated with the Loewe group of Berlin. There will also belong to this group various Paris banks, the Deutsche Bank, the German Orient Bank and its allied banks, the Berlin Electrical Enterprises Co. and the Belgo-Hungarian financial group of the Ganz Co. The extension and conversion of the tramways will require about £1,440,000, and the electric supply works and gas works will represent a further £720,000. In addition, the Deutsche Bank proposed to bring into the syndicate a scheme for the construction of an underground railway, which is estimated to involve an expenditure of £1,440,000. The three undertakings comprise a total of £3,600,000. The syndicate will subsequently form a Belgian company to take over the enterprises, the share capital to be £1,800,000 and the loan capital also £1,800,000. It is possible, the *Berliner Tageblatt* states, that the syndicate may succeed in obtaining the valuable telephone concession, as the Paris Thomson-Houston Co. and the "American Webb Co.," which acquired the privilege in June, 1910, are not willing, the newspaper declares, to take over the obligations which were subsequently imposed upon them. We are, however, able to say that this hope is purely an effort of the Teutonic imagination, for there is no foundation whatever for the suggestion here made. The future Belgian company will have on its board representatives of Germany, France, Belgium and Switzerland, and presumably also of Austria and Hungary.

Olympia.

One of our correspondents, who is either humorously inclined or must have a painful recollection of disappointment experienced at exhibitions which have been unfinished at the date of opening, writes suggesting that we should warn engineers, whose visit to Olympia must be confined to a single date, that some of the exhibits are almost certain to be incomplete during the first few days. And this was written three weeks in advance of the opening! Surely, if the next fortnight be utilised as it should be by exhibitors, everything will be ready in good time. Whatever has been in the past, cannot our firms show in 1911 how things *should* be done? Will those concerned take the hint?

AUTOMATIC TRACK CIRCUITS.

By an Engineering Correspondent.

Whenever a railway accident occurs, the correspondence columns of the public Press are filled with suggestions and recommendations from well-meaning people concerning the prevention of similar occurrences in the future. Speaking generally, a few of those recommendations are good, some are bad, the majority are impracticable.

An idea has been expressed that the duplication of signalmen would halve the risk attendant on lapses of memory, since the cases would be rare when both men would forget essential facts at the same moment. But such a remedy would not be infallible; it would lead in comparatively moderate signal boxes to a mutual slackening of the sense of responsibility through its being borne on two pairs of shoulders. For this reason the idea finds little support.

The prevailing notion appears to be that complicated mechanism will atone for individual failure or take the place of human intelligence and alertness. The fact should by this time be widely known that in the manipulation of railway traffic the personal factor can never be cancelled. Mind is worth more than matter, and without the intervention of the personal element at crucial situations, the finest inventions and most up-to-date equipment will only bring disappointment.

America has a genius for invention and organisation, but she is finding that over-elaboration of equipment can defeat the very end for which it is designed. Throughout that vast country railway administration is such that employment is reduced to the lowest possible proportion. In the vicinity of many large towns, the railways are equipped with automatic signals—some alternating, others direct-current systems—whilst immense tracts of territory are traversed by metalled roads throughout which the signalling arrangements are of the crudest description.

The best example of automatic signalling in this country is to be found on the Underground Electric Railways of London. A full description of the system, including an account of the signal boxes necessary to operate that company's crossings and termini, was published in the Electrical Review for March 22nd, 1907, and need not be repeated here. According to recent reports the average number of failures is small and the cost of operation satisfactory; but no one whose opinion really counts would affirm that the general introduction of automatic signalling on steam railways was an indispensable factor in the elimination of railway accidents. It should be remembered that the main line of a British railway is intersected with industrial sidings to an elsewhere unparalleled degree. The actuation of the points which give admission to those sidings is controlled by sentient beings; furthermore, a goods train having entered a siding and discharged a portion of its load, requires that someone should decide as to the propriety of its re-entering the main line.

When crossings or junctions exist, the problems become more complex; and yet it has been seriously urged that when two trains converge upon one section of line, track relays should be fixed at suitable points and operated by whichever train arrives first, to lower the necessary signals, and block the advance of the other train. Another writer suggested that when a train had to cross over from one main line to another, involving, as it would do, the moving of points, the operation of signals and the protection of itself from up and down trains, signalmen could be dispensed with and an arrangement fitted in the driver's cab whereby the condition of the line ahead could be ascertained, and, if clear, the occupant of the footplate could reverse the points in the direction required and proceed on his way. In answer to these proposals, it only needs stating that the automatic control of junctions and terminal stations is outside the purview of railway economics.

Close observers have noticed that accidents rarely occur on those sections of railway which are free from complications, but that serious mishaps more frequently take place in the handling of traffic as a result of failure on the part of the human factor. Apparently there exists a gap between the excellent appliances of the various railway companies on the one hand and the imperfect manipulation of the same in moments of mental aberration on the other. How to bridge the gap between complicated mechanism and human fallibility is the problem at issue.

In reporting upon the railway disasters of bygone years, it was customary for the Board of Trade Inspectors to recommend the provision of electric treadles, which apparatus served as an intermediate link in the chain across the gap referred to. Many of these appliances are in existence to-day and the statement may be ventured that they have been the means of preventing numerous mishaps at various crises.

But the test of experience with treadles has revealed several inherent limitations that militate against their extended usefulness, and this may be the reason why progressive railway companies are now adopting, and Board of Trade Inspectors are also recommending, short-distance track circuits in lieu thereof, which answer the same purpose in a far more satisfactory manner.

A treadle consists essentially of an iron box or bar fastened to the sleeper end or attached to the side of the running rail. This box or bar is furnished with a spring or mercury contact, normally open, but closed by the depression of the rail caused by the weight of an engine or coach passing over the spot where the apparatus is fixed. The closing of the electric contact brought about by this depression is utilised in completing a circuit that rings a warning bell or other device inside the signal box. The limitations of a treadle may be set forth in the following order:—(1) If an engine driver stopped short of a treadle, the depression would not be made, and an indication would not be given, though the engine might be actually standing a few yards away. (2) In the event of a train not provided with air brakes becoming divided, the first portion would pass over the treadle and ring a warning bell, whilst the rear portion would continue to foul that section which the signalman had reason to believe was clear. (3) If a battery failed or the treadle contact became inoperative, the signalman would have no immediate warning of these defects notwithstanding that the rail had actually been depressed by the passage of a train. Such a condition of affairs might in certain eventualities lead to serious results.

An automatic track circuit possesses none of these disadvantages, since every pair of wheels of every vehicle on the train would indicate their presence in an unmistakable manner, whether the circuit was 9, 90, or 900 yards long. Failure of the working parts would instantly manifest itself by a visual or audible warning; furthermore, the fracture of a rail metal outside the bonds would cause an alarm by

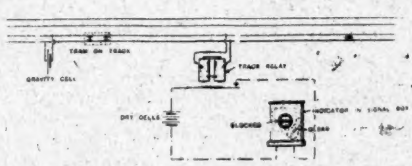


Fig. 1.—Short-distance Automatic Track Circuit, showing how the Presence of a Train on the Line is indicated at the Signal Box.

reason of the fact that current traverses the rails, and is not dependent for its action upon the depression of the lines, as is the case with treadles.

A study of the sketch (fig. 1) will show that a low-pressure current flows from a battery along one rail of the track through a relay and back to the battery along the second rail. The relay makes and breaks a local circuit which performs different signalling functions, according to special requirements. As soon as an engine or coach with metal wheels and axles enters the insulated section, a short circuit is established, the track relay becomes de-energised, and the local circuit is broken, which causes the safety appliance at the signal box to operate. This warning is continued until the insulated section again becomes clear. It is imperative that intermediate rail joints be suitably bonded, and that a metallic connection shall exist between the hub and the tire of every carriage wheel.

The essential parts of a track circuit may be summarised thus:—Four insulated rail joints, a gravity battery and

low-resistance relay, an indicator (200ω) showing "clear" and "blocked" positions, two dry cells and sundry connections.

Numerous are the applications to which track circuits are devoted, their chief uses being: (*a*) to denote the presence of a train by means of a reversible disk; (*b*) to lock the rear signal whilst a train occupies the advance section; (*c*) to restore the signal-arm to danger immediately a train has passed; (*d*) to lock the block during the time a train is upon the insulated track.

That any or all of these contrivances, separately or in combination, should be necessary as adjuncts to the existing lever frame interlocking, the absolute block telegraph appliances, the telephone and other electrical auxiliaries, is not undeserving of comment. This would, however, be an unwarrantable digression.

(*a*) Consider the means employed of reminding a signalman of the presence of a train, engine or trolley along a predetermined section of line. First, let it be clearly understood that whilst the insulated section of track is free from traffic, the indicator in the signal box is maintained at "line clear" position by the completion of a local circuit through the armature contacts of the track relay. Immediately a train or vehicle occupies any portion of the insulated section the line current is interrupted, a shunt is interposed, viz., the wheels and axles, thus depriving the track relay of its supply of electrical energy, whereupon the armature contacts are broken and the indicator assumes the "line blocked" position by gravitation. When the train has passed out of section the track relay is once more energised, and the indicator is automatically reversed.

(*b*) It can be argued that if a signalman neglects the block telegraph regulations, it is not unreasonable to assume that in a moment of forgetfulness he may overlook the additional warning supplied by the "track" indicator and lower his signal for the admission of a train into a section already occupied. Hence, it has been found desirable, in certain instances, automatically to lock the signal lever from the track circuit in such a manner that it is impossible to lower the semaphore while the section ahead is blocked. How this is accomplished may be gathered from an inspection of the second diagram (fig. 2). An imaginary case will best illustrate the idea. A manual lever is depicted with the object of showing its relation to the branch home signal. Suppose a train occupied the track section A B, and was merely waiting for the lowering of the branch starting signal to proceed on its journey, it will be obvious that under absolute block working the branch home signal should not be lowered for the admission of a second train

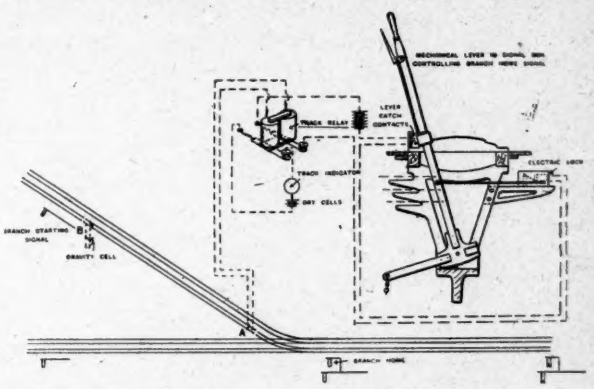
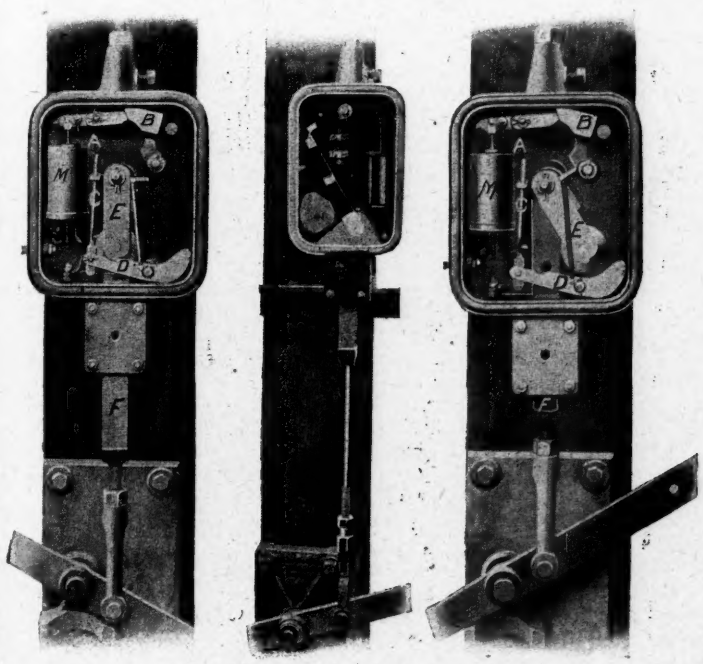


Fig. 2.—Automatic Control of Signal Lever and Track Indicator from Insulated Rail Track Circuit. Immediately a Vehicle occupies the Insulated Rail Section A B, the Armature of the Track Relay falls.

nto the section A B, and further that any efforts on the part of the signalman in the direction named should be frustrated. The wiring diagram (fig. 2) shows how such a safeguard may be effectively provided. One pair of insulated rail joints should be inserted at the heel of the junction and the other pair about an engine length beyond the branch home signal.

(*c*) Few words are necessary to explain the general utility of an arrangement whereby the "track" circuit automatically restores the signal arm to danger in the rear of a train irrespective of the signalman's movements. For this purpose "Sykes" signal arm replacers are extensively used, and, what is of equal importance, are eminently satisfactory. The apparatus is fixed between the balance weight lever and the signal arm, and moves with the upright rod when the arm is lowered. When in the moved position, the presence of a pair of wheels in the track circuit breaks down the relay circuit, as previously described, thus operating the "replacer" mechanism and resulting in the arm being put to danger. Sometimes the "replacer" is fixed under the cabin lever frame instead of at the signal, but the function performed is identical. By this arrangement a train protects itself in the rear upon its passage out of one section into another. In this connection the track circuit need not be more than one rail length.



a *b* *c*

a, Signal arm in normal position. When a train passes over the track circuit, current entering magnet M attracts armature A and releases hammer B, which falls on rod C and disengages the catch D from roller-arm E; weight of parts forces roller-arm to position shown in *c*. When the signalman replaces his lever, the slide F moves down, and the roller-arm is caught up by catch D.

Fig. 3.—"Sykes" Signal-Arm Replacer.

(*d*) In the block system of signalling a railway is divided into a number of sections by a series of signal boxes, not more than one train being allowed on one line in a section at one time. In each signal box there are block indicators, one for each line of rails in each section, electrically connected to similar instruments in adjacent boxes. If these appliances be connected to the track circuit so that the latter automatically locks the block needle in two signal boxes during the time a vehicle occupies any portion of the insulated section, a distinct advantage will have been gained.

The wiring sketch depicted in fig. 4 illustrates how such a combination is realised. It is not claimed that this represents finality, but it is in advance of what is being done in many parts of the kingdom, and

wherever it has been installed satisfactory results are reported.

Electric light and power engineers, who are unfamiliar with the practical application of electricity to railway signalling, naturally inquire whether it would not be more economical to arrange the wiring so that electrical energy was only absorbed during the time a vehicle occupied the insulated track section. The answer is in the affirmative, but economy is not everything; in this case considerations of safety have prior claim, and it cannot be denied that a closed rail insulated track circuit, properly installed, fulfils this condition in a perfect manner. It may be pertinent to inquire what constitutes a proper installation. In the first place, it is a fundamental principle in signalling that the failure of any part of the system shall result in the signal going to danger. Therefore, in designing a track circuit, care has to be exercised in preventing a wrong indication whenever an electrical fault develops.

The poising of a track relay, though apparently a trifling detail, is really an important item. In each of the sketches,

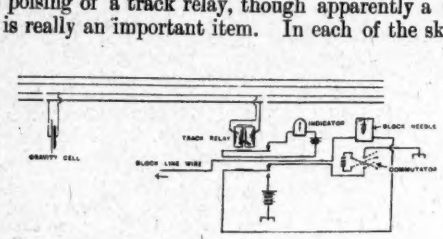


Fig. 4.—Short-distance Track Circuit inter-connected with the Block Apparatus, so that the Presence of a Train is recorded on a Track Indicator, and also on the Block Instrument in the adjacent Signal Boxes.

figs. 1, 2 and 4, the armature is shown below the coils, whereas the usual position is on the side. This precautionary measure is justified on the grounds of safety, since a broken armature spring or an interruption of the current would cause the armature to fall away from the core and thus ensure a disconnection in the local circuit.

Another important condition is that a D.C. track circuit should be installed in strict accordance with Ohm's law.

The resistance between the rail metals is lower when the ballast consists of cinders than when the sleepers are packed with stone chippings. There is an immense difference in the ballast resistance between a wet and a dry day. Ordinarily the current tends to creep across the sleepers and back to the battery without having performed its proper functions at the relay end; it is necessary, therefore, to ascertain the ballast resistance under the worst possible conditions. Having obtained this datum the adjustment should be such that the relay armature is on the verge of falling during the worst weather conditions, the battery being in fairly good order. This not only admits of a factor of safety; it ensures that the chargeman is giving due attention to maintenance.

The resistance from rail to rail under wet or snowy weather conditions should never be less than that of the track relay in that circuit, and since the ballast resistance decreases in direct proportion to the length of the track circuit, it follows that the longer the insulated section the lower the resistance of the relay, so as to ensure that the necessary current will pass through the relay coils. On the other hand, it is of the utmost importance that a carriage truck or horse box should register its presence as an effectual shunt whenever such vehicle is detached from a train and left on the main line.

City Fire.—Owing to the outbreak of fire at Messrs. Ward, Lock & Co.'s premises, Messrs. C. H. Cathcart & Co. are unable to continue business for a few days, and the indulgence of the trade is asked for. They would be glad of new sets of lists from all firms who issue catalogues, as the whole of their stock is spoiled.

Hungary.—It is reported that the Ericsson Co., of Stockholm, Sweden, are in negotiation with a Buda-Pesth syndicate with regard to the establishment of a branch telephone factory in Hungary.

THE BRITISH ASSOCIATION.—I.

On Thursday, August 31st, the Association settled down to sectional proceedings, and, as usual, our chief interest centres in the doings of Section G (Engineering). Before delivering his address, the chairman, Prof. J. H. Biles, referred to the fact that the programme of the Section this year was a good one. The papers were grouped under sub-sections which facilitated the attendance of those who were specially interested in the subjects, and so stimulated discussion. On Friday there was to be a series of papers connected with the application of electricity to ships and to other engineering purposes. On Monday there was to be an important joint discussion with the Mathematical Section on "Flight"—a discussion in which two kinds of investigators, pure and applied, would meet together. Papers on radio-telegraphy and wireless telegraphy would follow, and on Tuesday there would be an important morning on prime-movers, when the question of what was the best type of prime-mover would be brought right up to date and properly discussed. There would be a meeting on Wednesday, for papers were still coming in.

After the chairman had read his address to an audience of about 80 persons, the president (Sir Wm. Ramsay) moved the usual vote of thanks, and this was seconded by Mr. Alexander Siemens, who said that the address had considerably interested him owing to his connection with cable-laying operations. The motion of the ship was of importance because of its effect upon the cable that was being laid, and anything which contributed to our knowledge of rolling and how to prevent it was most acceptable to cable-makers. Mr. Worby Beaumont next occupied the attention of the Section with his paper on the origin and production of corrugation on tramway rails. Mr. Siemens, in opening the discussion, thought that the difficulty would be overcome by constructing rails with hard resisting material on the sides, the head of the rail being of soft material, everything being so calculated that the soft material was elastic so as to take its old form again after the wheel had passed. They would thus have the remedy that the wheel would not touch the rail in a line as it did at present, but would be bedded, and thereby the pressure per square inch would be so much reduced that the crumbling need not take place. Sir W. H. White related experiences of his own bearing upon the subject, though not connected with tramway rails, and said that he did not find himself in agreement with Mr. Siemens as to his remedy, which he described as "a dream." Among the other speakers was one who said that it was by no means impossible to make the tire surface of the wheel capable of yielding so as to increase the line contact to some larger area. It might be possible either by reducing the stiffness of the tire itself, or by a layer between the outer tire and the wheel, to get a larger contact. Mr. Beaumont replied at some length to the discussion. In regard to the question of speed, a great many users and running authorities in different towns held that it was impossible to reduce the speed; the great trouble was that tramcars being on fixed lines were obliged to make very high speeds when they could get a chance to do so, in order to retain traffic. It came down to the commercial question as to which method was the best, or which would survive. The rail mentioned by Mr. Siemens would be a reversion to the old wrought-iron rail used years ago, which gradually spread sideways, being of material which could be kneaded on two strips along both sides of the rail. It was perfectly true that larger wheels could not be used on tramcars at the present moment, but he thought that electric motor-propelled vehicles were being used in the streets which suggested that by modification of the car it would be possible to use larger wheels for the tramcar. As to the elasticity of Mr. Siemens's rail, he was afraid it was more in the nature of ductility. The question was a commercial one, and in certain tramways it was bringing the cost of repairs and renewals of permanent way up to such a figure that it was becoming improbable that tramcars would be able to run excepting where they were kept going out of the rates.

The remainder of the morning was devoted to an account,

by Mr. G. K. B. Elphinstone, of the Anschutz Gyro-Compass. The attendance was very gratifying as indicating the great interest that is taken in this instrument, of which the author gave a clear description illustrated by a number of photographic and diagrammatic lantern slides, the compass itself being subsequently shown to a large number of his listeners in an adjoining room.

On Friday morning the chief feature of the Section was the consideration of Mr. H. A. Mavor's paper on "Electrically-driven Ships' Propellers," and Mr. B. P. Haigh's contribution on "Electrical Steering." Both of these authors made very profitable use of the lantern, and both of them were rewarded with a discussion which elicited many points of interest. We shall refer in a later issue to the contents of these papers and the questions which arose in the discussions. The attendance fell away with remarkable suddenness when the meeting turned its attention to the next business in the programme, and Mr. T. F. Wall's contribution on "The Single-phase Repulsion Motor" was given to a gathering of 18 all told—probably there was some counter-attraction elsewhere which exercised a greater pull at this particular moment. Interest was renewed somewhat when the more popular subject of human susceptibility to vibration was introduced by Captain H. Riall Sankey, on behalf of Mr. W. Pollard Digby and himself. The subject was both human and humorous, and provided a welcome occasion for light reading and conversation after three hours or thereabouts of really serious proceedings. Two brief reports on gaseous explosions and aluminium alloys respectively having been taken as read, members betook themselves to a corner of the hall, where they were able to discover, by means of the Vibragraph already described in our pages, their own degree of susceptibility.

In accordance with the usual custom the Sections did not sit on Saturday, but adjourned until Monday, when Section G resumed its proceedings with the joint discussion on aeronautics referred to by the chairman, and demonstrations of wireless telegraph apparatus.

The following is a list of the papers and reports considered in the Engineering Section (G), on Thursday and Friday last week, and from Monday to Wednesday this week :—

Presidential address, Prof. J. H. Biles.
"On the Origin and Production of Corrugation on Tramway Rails," by W. Worby Beaumont.
"The Anschutz Gyro-Compass," by G. K. B. Elphinstone.
"Electrical Drives for Screw Propellers," by H. A. Mavor.
"Electrical Steering," by B. P. Haigh.
"The Single-Phase Repulsion Motor," by T. F. Wall.
"Some Preliminary Notes on a Study as to Human Susceptibility to Vibration," by W. Pollard Digby and Capt. H. Riall Sankey.
Report of Committee on Gaseous Explosions.
"Some new Aluminium Alloys," by Prof. E. Wilson.
Joint discussion with Section A (Mathematical and Physical Science) on "Aeronautics," opened by A. E. Berriman.
"Recent Developments in Radio-Telegraphy," by Prof. G. W. O. Howe.
"Portable Equipment for Wireless Telegraphy," by Capt. H. Riall Sankey.
"Economical and Reliable Power Generation by Over-type Superheated Steam Engines," by W. J. Marshall.
"Suction Gas Engines and Producers," by W. A. Tookey.
"Diesel Engines," by Chas. Day.
"Crude Oil Marine Engines," by J. H. Rosenthal.
"The Manufacture of Nitrogen Compounds by Electric Power," by E. Kilburn Scott.
"Smoke Abatement; the possibility of fixing a new standard of smoke emission from factory chimneys," by Dr. J. S. Owens.
"A New System of Continuous Transportation for Passenger and other services," by W. J. Lewis.
Among the papers, reports, &c., read in Section A (mathematical and physical science) were the following :—
"The Infinitesimal Transformation of an Electromagnetic Field into itself," by H. Bateman.
"A Friction Permeameter," by W. H. F. Murdoch.
"On the work done at the Bureau of Standards on the Absolute Measurements of Electric Current," by Prof. N. E. Dorsey.
"The Specific Heats at High Temperature and the Latent Heats of Metals. Part I, Aluminium and Zinc," by H. C. Greenwood.
Report of Committee on Experiments for Improving the Construction of Practical Standards for Electrical Measurements.

In the Chemistry Section (B) a report on "Electroanalysis" was submitted by a Committee; also a report on "The Present Position of Electric Steel Making," by Prof. Andrew McWilliam, A.R.S.M., M.Met.; and a report by a Committee on the "Influence of Carbon and other elements on the Corrosion of Steel."

In the Agriculture sub-Section the following were submitted :—
"The Effect of Minute Electrical Currents on the Growth and Metabolism of Bacteria," by J. H. Priestley and Miss E. M. Lee.
"The Effect of High-Tension Electric Discharges and Current Electricity on Plant Respiration," by J. H. Priestley and R. C. Knight.

In the Physiology Section a report on "Electromotive Phenomena in Plants" was submitted.

Suction-Gas Engines and Producers.

By W. A. TOOKEY. *Section (G) (Abstract).*

THE paper is essentially a comparison of engine performances on the test bed with results obtained in daily operation, together with some notes on the working costs for fuel, oil, labour, &c. The performance results cover suction gas-power plants of various types and different capacities when the output over the period of test can be measured by the generation of electric current and the raising of water, so taking into account the combined efficiencies of the electric or pumping machinery and that of the gas-power plant. The author acknowledges the abnormal conditions under which some "test" figures are taken, and offers further figures compiled from statements of users in various parts of the world, taking into account the variations of consumption due to the different grades of fuel used, the variations of output, load fluctuations, length of stand-by periods, and variation in the human element. From records of non-stop runs, it is pointed out how reliable these installations are and what little attention is really needed, provided the man in charge efficiently discharges his duties, and the engine is properly correlated to the producer, and the latter to the quality of fuel and the rate of its combustion. Figures relative to the consumption of lubricating oil are included, as being of special interest in view of the criticisms that have been made in this respect. These are moderate, especially when the oil is filtered for re-use on other machines. Capital cost for producers and engines erected is dealt with, including the cost of buildings. Finally, a discussion of the relative advantages of liquid-fuel engines of the Diesel type and of the suction-gas plant is given, the author inclining to the opinion that, although, according to test results, it would appear that suction-gas engines and producers are threatened by a competitor which offers nearly equal cost of operation, there are claims of a negative kind which must incline the balance of advantages in favour of the gas power plant, at all events for moderate powers, for surging loads, and for duties which

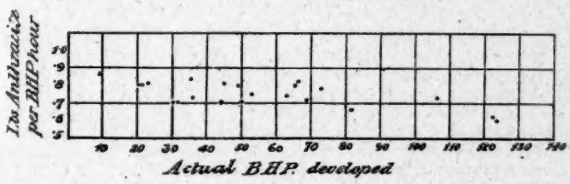


FIG. 1.—CHART SHOWING FUEL CONSUMPTION IN B.H.P. TESTS.

many years of experience have shown cannot be efficiently performed with economy by compound condensing steam engines.

Dealing first with the B.H.P. tests, the author shows that, dependent on design and state of manufacture, the actual consumption of combined engines and producers working on anthracite is between 0·7 and 0·85 lb. per B.H.P.-hour, and that the uniformity of coal consumption ranges from about 10 to over 220 B.H.P. Most of the test results in his first table, on which he establishes these figures, are due to M. Mathot. Fig. 1 shows a target diagram, giving the fuel consumption results obtained under such test conditions, while fig. 2 indicates graphically the relation between the actual piston displacement per cycle per minute per B.H.P. developed and the coal consumption in lb. per B.H.P.-hour. It will be seen that the limits are closely defined. With best fuel and most skilled attention, 1 B.H.P. can be developed with a piston displacement of 3·5 cb. ft. per minute, while with conditions less favourable, a displacement of 4·5 cb. ft. per minute per B.H.P. is required. There seems to be no diversity in the consumption figures as a consequence of variation in the size of the unit. It is also shown in the table above referred to that when working at about half load the B.H.P.-hour can still be obtained from less than 1 lb. of anthracite under the average conditions of tests. In support of this, a test curve, by Prof. Aimé Witz, of a Winterthur engine fed with town gas was shown, the amount of heat admitted to the cylinder in the form of gas being plotted against KW. outputs, and it appears that the consumption in calories per KW. does not rise appreciably till the load is below one-half the maximum capacity of the engine.

The second portion of the paper deals with consumption figures in actual practice. The factory owner desires to know what he can expect the average consumption of a gas engine and producer to be when the engine is working throughout the day under loads that are ever varying according to the work passing through the driven machines, how far the test figures will be affected by the unavoidable losses due to the continued slow combustion of the fuel during stand-by hours, and also the probable total fuel con-

TABLE I.—Actual Working Results obtained from Combined Gas Engine, Suction-Gas Plant and Dynamo Sets.

H.P.	Maker.	User.	—	KW.-hrs. per hr.	Fuel.	Per annum.	Lb. per KW.-hour.	Pence per KW.-hour.
Two 20	Campbell	Great Eastern Railway	46 hrs. per week	13·8	Anthracite at 31/6, and waste carbon-ends	£45	1 935	0·3265
65	Gardner engine (Mersey producer)	Walton-on-Naze Elec. Works	10 % load factor	—	Anthracite	—	2·9	0 632
96	Campbell	Broxburn Elec. Station	9 hrs. per day, 15 hrs. stand-by	46·5	Anthracite at 16/9	—	1·48	0·133
115	Hornsby-Stockpt.	Ascot District Gas & Elec. Co.	—	—	Coke at 16/6	—	—	0·197
120	Campbell	Workington Bridge & Boiler Co.	53 hrs. per week	37·9	Coke screenings at 8/- per ton	£52	2·9	0·1243
Two 250	Westinghouse (Campbell producer)	Davis & Timmins, Ltd.	273,583 units per yr. of 2,712½ hrs.	109	Anthracite at 30/-	—	2·15	0·246

sumption, in order to fix upon the maximum capacity of an engine he is about to purchase, as, although he wishes to provide plenty of margin to cope with future extensions, or to minimise the effect of the development of a fault in either the gas producer or the engine which may temporarily restrict the amount of power available per explosion, yet he does not want to put down a larger engine than necessary, if that larger engine will result in a greatly increased bill for fuel. The author gives what he believes to be reliable figures, compiled from users' reports received by makers of producers and gas engines. Fig. 3 shows graphically the relation of rated H.P. to hourly consumption of fuel, the uniformity of results being noticeable; only in one or two cases do the performances nearly approach the figure that would be reached if the fuel consumed amounted to 1 lb. per rated B.H.P.-hour—even when, as in all the cases mentioned, stand-by and all other losses are included. Speaking generally—and none but general assumptions can be made upon

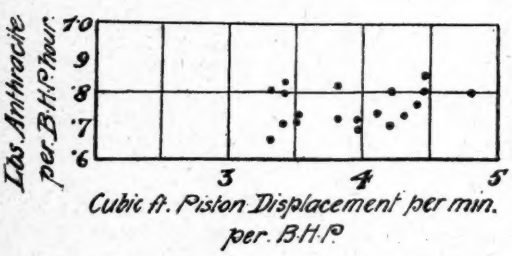


Fig. 2.—Chart showing Relation between Consumption of Fuel per B.H.P.-Hour and Specific Piston Displacement per B.H.P.-Minute.

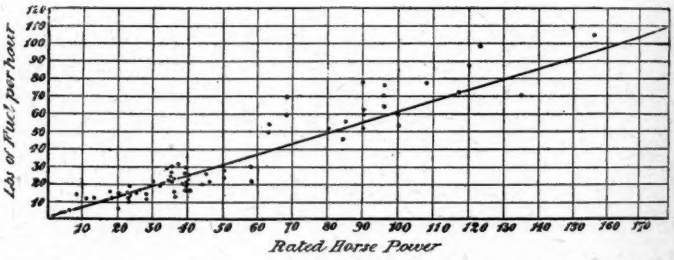


Fig. 3.—Actual Hourly Consumption of Fuel, including Variations due to Different Grades of Fuel, Load Fluctuations, Different Load Factors, Length of Stand-by Periods, Ability of Attendants, Rate of Combustion in Producer, &c.

such a table—it would appear that the average consumption of fuel of suction gas plants is at the rate of 0·6 lb. of fuel per rated B.H.P. per hour, inclusive of all losses. Taking the group of engines between 30 and 50 rated B.H.P., in a score or more of engines all working with different kinds of fuel, in different districts, in charge of men of different ability, driving machinery at work for different numbers of hours per day, and with different load factors, and with a constantly differing rate of output, involving, apart from differences in the size and styles of producers, different rates of fuel combustion per unit of fire area, it is to be noted that a difference of 10 lb. of fuel per hour or thereabouts represents the higher and lower limits of fuel consumption.

From this the author develops two arguments, the first being that no other form of prime mover in units of equal size can give the same low record of fuel consumption, and that even with the improvements in steam engine practice made in recent years, no type exists that with an efficient boiler can be sold at such a price and be run for such a cost as will successfully compete with the gas power plant. The second argument is that to obtain the best results from a gas power plant it is not only the production of good gas that matters, but also the admixture of that gas with a suitable quantity of air to form an explosive mixture within the walls of the engine cylinder. Upon the efficiency of such proportioning of the mixture on the part of the attendant depends the amount of energy obtained per working stroke, and thereby the power and economy of the engine are at once affected. That such low hourly consumptions can be so universally obtained with suction gas plants proves that the attendant is powerless to affect the economy to any appreciable extent, and conversely that the necessary manipulation is so readily learned that the factory owner can safely rely upon uniformly economical working. In a steam plant, on the other hand, it is well known that coal can be wasted by neglect to control the combustion during stand-by hours. In many cases, owing to carelessness or neglect, the stand-by losses are permitted to reach 10 lb. per stand-by hour instead of from 4 lb. to 5 lb., which is the usual figure in practical working. The lowest stand-by consumption known to the author is one of 1 lb. per hour, but this is rarely obtained, it being necessary, in order to ensure the fire being in a fairly active state for ready quickening in the morning to the gas-making temperature, to allow rather more air to pass through the furnace than is there implied.

The author then passes to the performance of suction gas plants and gas engines combined with dynamos or pumping plants. For electricity production test performances are given for plants varying from 30 to 250 rated H.P. running on gas works coke or anthracite. The consumption in pounds of fuel per kilowatt-hour ranges between 1·24 (a 45-H.P. Campbell-Morris-Hawkins set) and 1·675 (a 68-H.P. Tangye-Cie. Anon. Continentale combination), and in order to compare the test figures with those obtained per KW.-hour in actual practice, with varying load factors and different conditions of working data, shown in Table I are given. From this it is evident that the average consumption, including stand-by losses and other wastage of fuel, the latter being burnt at different rates of combustion, and being of different grades of quality, amounts to about 2 lb. of anthracite per KW.-hour. In cases where this figure is exceeded it will be observed that the fuel is coke, while in one instance the load is on the engine for only four hours out of the 24 when anthracite is used. The test results on the pumping plants, as expressed in foot-pounds of work performed per 100 lb. of fuel consumed by the different plants, vary widely, the author explaining this by putting down the divergencies to the varying efficiencies of the pumping machinery.

As regards general reliability, the author quotes the statement made by, or on behalf of, the Workington Bridge and Boiler Co., after changing over from a compound horizontal enclosed engine with forced lubrication, fed by steam at 80 lb. pressure from a Lancashire boiler, that, "As regards reliability, there is practically nothing in it between the two; possibly the steam plant has the advantage, if anything, as regards actual stoppage." In this case the working costs were reduced from 1·195d. to 0·452d. per unit, including fuel, labour, oil, water, repairs, &c. The author points out that two developments in gas-engine design have improved its elasticity of output: the first is throttle-governing as opposed to the "hit and miss" principle, throttle-governing having the advantage of greater smoothness of running due to the graduated force derived from consecutive explosions, instead of a greater or lesser number of explosions of full intensity, which makes for so distinct an improvement, while the diminution of working stresses in the more important working parts gives consequent longer life. The other improvement is increased rotative speed. In the author's opinion the increase in the rate of power generation per unit of time, and consequent greater ability to deal with sudden increases of load without the slowing of the engine, is a very decided improvement. For any engine to be successful under working conditions, it is necessary that the generation of power shall be equal to the rate of absorption of power. Machinery of some descriptions demands an output of power, for perhaps but a few seconds, much greater than that required over a greater period. If the engine were to be no larger with regard to output capacity, but of quicker revolutions, the rate of power generation would be greater per instant of time, and it would thus be able to cope more successfully with momentary overloads. The higher speed of revolution that is now common practice, coupled with the improved method of throttle governing, undoubtedly brings the gas engine into a position more favourable to withstand the criticism of lack of overload capacity that has so frequently been levelled against it.

The author reviews the methods of lubrication adopted in older types of gas engine, whereas in most modern engines the lubrication of the cylinder and that of the gudgeon pin are separately provided for. Forced lubrication is fitted to the cylinder and the piston, the quantity of oil pumped per stroke being adjustable to

meet varying grades of oil and varying temperatures which affect viscosity. The main bearings are provided with oiling rings, which, constantly dipping during their rotation on the shaft into an oil-well formed below the bearings, enable the same oil to be used over and over again without waste. Therefore, the consumption of lubricating oil has now been brought down to extremely low figures, while after filtration most of the oil can be used again upon the line shafting and general machinery of the factory. In the latest types of gas engine there is a fair degree of uniformity in oil consumption to some extent independent of size, as shown in Table II. The reduction of consumption to a third, due to filtering as shown in lines 3, 4 and 5, are interesting. As regards consumption of water for washing the gas, generating the water vapour in the producer and cooling the engine cylinder, the author gives test figures due to M. Mathot, indicating that the water used depends on the men in charge. The figures range from 3·64 gallons per B.H.P.-hour for an Otto Deutz 232·83-B.H.P. engine to 15·15 gallons for a Delamarre 75·86-B.H.P. engine, other figures being given for generator only.

TABLE II.—Consumption of Lubricating Oil. Working Results.

Maker.	B.H.P.	Pints of oil per hour.	Remarks.	User.
Tangye	Three 63	0·422	Engine & pumps	N. E. Rly., York
,,	68	0·278	No filter 1st yr.	Cie. An. Continentale
,,	68	0·1044	Filter 2nd yr.	,,
,,	68	0·0947	Filter 3rd yr.	,,
,,	68	0·55	Engine & dynamo	—

much as 42 per cent. of the total heat value of the fuel is represented by the work performed upon the piston of the engine as recorded by the indicator, whereas the equivalent of a consumption of 0·7 lb. of anthracite per B.H.P. with a combination of gas engine and suction-gas producer would represent a thermal efficiency, on the I.H.P. basis, of but 31 per cent. The consumption of liquid fuel per B.H.P. with a Diesel engine is usually at the rate of 0·45 lb. per hour. The price of the oil fluctuates according to the ruling market prices, but for the present purposes can be fixed at 50s. per ton. At this rate the cost per B.H.P.-hour is about 0·12d. Upon the basis of 0·7 lb. of anthracite per B.H.P.-hour, 30s. per ton, the cost of fuel for the suction gas plant is 0·1125d. As far as fuel cost alone is concerned, there is not very much to choose between the two types, and the decision to install the one or the other must rest upon other considerations. One very serious consideration to the disadvantage of the Diesel engine is the matter of capital outlay, involving as this does not only increased annual standing charges for interest on the sum expended beyond the relative cost of a suction gas installation of equal power, but also the allowance for depreciation must be increased in proportion. In some instances, where the engines are of considerable capacity, and are working long hours with sufficient load to enable low consumption to be taken full advantage of, and where local conditions are least favourable to the gas power plant, the balance inclines to the use of the Diesel engine. But even then the gas power plant, calling as it does for attention of a less skilled nature, can frequently be run at a lower rate for attendance, while the consumption of lubricating oil is usually lower. As regards the semi-stationary steam engines combined with a high-pressure boiler with superheater, jet condenser, with two-stage or compound expansion, from test results it has been found that under full loads the consumption of fuel per B.H.P.-hour has been brought to the low figure approximately of 1 lb. of coal, and this being so, the steam engine has been able to show to much better

TABLE III.—Combined Costs for Fuel, Oil and Attendance.

H.P.	Maker.	User.	Remarks.	Fuel, pence per hour.	Labour, pence per hour.	Oil and stores, pence per hour.	Total, pence per hour.
Two 132	Campbell	Glaholm & Robson, Sunderland	Anthracite 104 tons, coke 52 tons, and town gas to eke out power	17·0	9·25	3·74	30·0
One 140 and one 40	Crossley	Arrol-Johnstone Car Co.	Anthracite at 15s. 6d.	10·75	5·35	·642	16·75
Three 63	Tangye	N.E. Railway, York	—	7·0	6·0	·965	14·0
Two 150	Westinghouse	Davis & Timmins, Ltd.	Anthracite at 30s.	35·0	14·6	5·34	55·0
96	Campbell	Broxburn Elec. Station	Anthracite at 16s. 9d.	7·7	4·95	1·18	13·83
50	Hornsby	F. B. Grant & Co., Teddington	82 weeks, 4,587 hours	4·4	2·22	0·602	7·2
39	Tangye	Robt. M. Stirling, Glasgow	Anthracite at 11s. 6d.	1·18	1·0	—	2·18

Table III has been compiled to show the actual working costs per hour of engines of various sizes, using fuel of different qualities and at varying prices, as regards the three chief items of fuel, oil (including waste, rags and other stores, in some cases) and attendance. In engine repairs and renewals, the chief items of expense occur in the renewal of piston rings, refacing and perhaps renewal of exhaust valve, re-boring or renewal of the cylinder liner. The bearings require occasional refitting, but rarely need re-lining. As far as the piston rings are concerned, the usual rate of renewal is at the rate of about one a year. The exhaust valve may need to be replaced about once every four or five years, while the life of a liner and piston can be taken as on an average about seven years. Of course, these periods vary according to the actual number of hours worked during the periods referred to, and according to the attention given to minor matters, such as re-bushing of levers, replacement of worn pins and spindles which, if neglected, may cause excessive deterioration of other working parts. As far as the producer is concerned, the firebricks lining the generator require to be renewed about every two years, for which the material costs little, besides the time occupied in dismantling and re-erecting, which runs into about three days. Generators made with sheet-steel casing will usually require patching around the part exposed to the action of the heated gases within the ashpit after about five years of work, and perhaps renewal of this portion about every seven years. Cast-iron is preferable for this portion of the apparatus, but is only used for the smaller powers on account of first cost. Fire-bars will be wanted about every two years or at longer periods, unless the fire is worked at a high temperature, arising from an insufficiency of steam, which causes burning out. The cost of all these is not more than that of similar work on steam plant, including cleaning, scaling, preparing boilers for inspection, and repairs to auxiliary apparatus. As to capital outlay, the cost—including engine, producer, pulley, water-circulating tanks, piping (to what gas-engine makers call "standard arrangement"—that is, when the component parts are disposed within about 20 ft. from one central point), foundation and builders' work, and average labour in erection, but not including cost of space occupied or any special buildings required—ranges from about £140 for a 10-B.H.P. installation to about £1,100 for a 155-B.H.P. installation. From 150 to 50 B.H.P. the total cost is at the rate of about £7·5 to £8 per B.H.P. From 40 B.H.P. downwards the rate per B.H.P. increases, ranging from about £9 to £11·5 in the smallest size.

The author institutes some comparisons of suction-gas engines and producers with Diesel engines and semi-stationary steam engines. As regards the former, repeated tests have shown that as advantage than ever before in competition with the suction gas engine. In the latest designs of semi-stationary engines special attention has been given to accessibility of the boiler tubes and the superheater, to enable the necessary cleaning to be carried out with thoroughness and dispatch; but with a gas engine there is no excessive temperature or high pressure in any part of the apparatus other than within the engine cylinder, and then only for but a fraction of a second. A further advantage in favour of the suction gas engine and producer is that with the latter the attendant can be engaged in other work throughout the factory, and need give only occasional inspection when fuel charging at long intervals. With the steam plant, a man has to be constantly in attendance to keep the fire going, while it is well known that the manner in which the stoking itself is carried out frequently affects the fuel consumption by as much as 15 to 20 per cent. Water softening and purification plant, by adding to the capital cost, has sometimes to be added to the steam plant, while sudden fluctuation of load involves some waste of fuel in blowing off excess steam.

In conclusion, the author gives mention to the recent developments in the utilisation of factory waste, such as wood chips, sawdust, cotton seeds, &c., for producer fuel, and to the use of bituminous coal in the place of anthracite.

The Diesel "Oil" Engine.

By Charles Day. *Section G.* (*Abstract.*)

The economical generation of power for industrial purposes depends mainly upon the following factors:—

1. (*a*) The attainable economy of working at different loads of the prime mover itself, including boiler or gas producer, and all accessories such as condensers, feed pumps, water pumps, &c.

(*b*) The degree to which this attainable economy can be practically maintained under the conditions of working, and the load factor.

2. The stand-by losses, *i.e.*, the expenditure necessary to keep the plant ready for work when wanted.

3. Wages of engine-room attendants, stokers and other men employed about the power house.

4. Expenditure on lubricating oil, cleaning, waste and sundry stores.

5. Cost of repairs and of the maintenance of all parts of the plant in good working condition.

6. The cost of water for condensing, and for boiler feeding in the case of steam plant, for the engine water jackets, and for the gas producer in the case of gas plant, or for the engine water jackets in the case of Diesel plant.

From the mere enumeration of these items, it is very obvious that tests either on makers' works, or on site, even though the tests extend for a week or so, do not form a sufficient guide as to the real value of the engines for industrial purposes, and that a far safer, in fact, the only safe conclusion, can be formed from a study of results obtained in actual practice. For instance, it matters not how economical an engine may be in regard to fuel if the expenditure in other directions more than out-balances the gain in fuel consumption.

In actual service it is not to be expected that power plant can always be kept and worked at its highest efficiency. The average results actually obtained over a term of years differ considerably from those attainable under the very best of conditions.

The great difficulty most buyers find is in securing reliable figures of power costs from people engaged in trade, except in the case of electric supply stations. The writer does not know of any body of large power users who systematically prepare accounts showing their power costs on a uniform basis and publish them. This practice in connection with electric supply stations fortunately does give an independent and authoritative basis from which valuable deductions can be made. The figures published in the *Electrical Times* cover practically almost all the supply stations in Great Britain, and this information, combined with information obtained direct from station engineers, has enabled the author to determine the average results obtained in such stations. With different types of plant these averages, for stations having a plant capacity not exceeding 1,000 H.P., are as follows :—

TABLE I.—Average Cost per B.T.U. Sold.

Type of engine.	Fuel.	Lubricating oil, waste, stores and water.	Wages.	Repairs and maintenance.	Total works cost.	Load factor.
Steam...	·45d.	·06d.	·25d.	·26d.	1·02d.	14·7
Gas ...	·43d.	·09d.	·28d.	·24d.	1·04d.	15·3
Diesel...	·23d.	·04d.	·19d.	·07d.	·53d.	14·3

The limit of 1,000 KW. was fixed owing to there being as yet no large electricity supply stations equipped solely with Diesel engines or gas engines. Of course, better results are obtained when driving machinery which gives a better load factor, but the causes which produce loss are, as a rule, the same, though modified in extent. The general conclusion formed from a study of electricity stations holds good for the great majority of power users, though, perhaps, not applicable to some special trades, where engines can be run continuously on almost uniform loads. It is also necessary to point out that the figures include some items which should not strictly be charged against the power plant. For instance, the wages items include figures for men working on cables, street lamps, and in sub-stations, whilst the repairs items include repairs to such parts. Also it is necessary to mention that the figures give the costs per unit sold and not per unit generated.

From the averages it is clear that a substantial gain is obtained by the adoption of Diesel engines, as against either gas or steam engines, the figures being beyond doubt substantially accurate. It is also noticeable that the gain is not only on fuel consumption, but is practically in the same proportion on the other items of expenditure.

The great saving shown by these average figures is confirmed by repeated experiences of the author. In many cases, although the figures guaranteed with Diesel engines have been no better than figures previously guaranteed, and obtained on tests, with existing steam and gas engines, the Diesel engines have shown over extended periods a saving of 50 and 60 per cent., and in some cases an even greater percentage, the result being due to the fact that the Diesel engine's average working results were very much nearer to the guaranteed figures than with gas or steam engines, combined with the fact that the relatively high cost of working at light loads with gas or steam had not been sufficiently taken into account when considering the guaranteed figures.

When going through cost records to prepare the average figures previously given, the author noticed very wide differences of cost per unit, particularly in the case of the steam plant. He therefore had the average cost calculated for steam stations of different capacity, and as the results are interesting, they are given separately in Table II.

The table shows the great improvement which follows increase of size with steam stations, or expressed in the reverse direction it shows how great is the disadvantage of small stations when steam power is used.

It is further to be noted that even with the largest steam stations, the costs per unit generated are no better than for quite small stations using Diesel engines, and this in face of the improved load factor. This is a most important point, and shows that small Diesel stations can profitably supply at prices hitherto thought to be obtainable only in densely populated centres having large power stations.

In all cases the figures which have been given are works cost, and do not include anything for interest on capital and depreciation. It is hardly possible to give a definite statement showing the cost of constructing and equipping power houses of different types, as there are so many variable factors. However, the author's experience of a considerable number of estimates indicates that up to a capacity of, say, 1,000 KW., there is generally little difference between the gross capital expenditure required, whether steam, gas or Diesel engines be adopted.

Having now dealt with what may be termed the commercial aspect, it may be well to study briefly the constructional features desirable in engines for dynamo driving. For speeds

TABLE II.—Average Works Cost per B.T.U. Sold, on Steam Stations of Different Sizes.

Capacity of station not exceeding	Fuel.	Lubricating oil, waste, water and stores.	Wages.	Repairs and maintenance.	Total.	Load factor.
KW.	d.	d.	d.	d.	d.	
250 ...	·63	·09	·35	·36	1·43	13·2
500 ...	·56	·06	·27	·29	1·18	13·3
750 ...	·43	·05	·23	·24	·95	15·4
1,000 ...	·40	·05	·23	·21	·89	16·8
1,500 ...	·42	·04	·17	·18	·81	16·9
2,000 ...	·37	·04	·16	·21	·78	17·7
3,000 ...	·33	·04	·15	·17	·69	17·4
4,000 ...	·40	·03	·14	·20	·77	18·8
5,000 ...	·34	·03	·11	·16	·64	18·7
7,000 ...	·36	·04	·13	·20	·73	17·9
10,000...	·26	·03	·09	·13	·51	22·6
20,000...	·30	·03	·11	·16	·60	19·6
50,000...	·23	·02	·10	·11	·46	20·56

which are not slow, engines of the multi-crank type become desirable, otherwise serious vibration is likely to be caused. For the same reason it is important that the distance between the centre lines of the cylinders of an engine be reduced as much as possible, and on this account the vertical construction is much more suitable than the horizontal, and gives much better accessibility. The vertical design is also better from the point of view of piston wear.

Very complete enclosing, combined with forced lubrication, is in the author's opinion an absolute essential for high-speed engines, whether steam, gas or oil. With the first few oil engines to which forced lubrication was applied, a portion of the lubricating oil got drawn up into the cylinders. Improvements in construction have, however, completely overcome this, and now the oil consumption is quite as low with the forced lubrication as with the ordinary systems. For moderate speeds of revolution, ring lubricating main bearings are thoroughly satisfactory, combined with centrifugal lubrication to crank pins. With such an arrangement less complete enclosing meets all requirements of cleanliness.

There is another point in regard to the multi-cylinder design of engine which should be mentioned, viz., that with this design a smaller diameter of cylinder is required for a given power than with a single-cylinder engine. With internal combustion engines this is of great importance, as, after a certain size, every enlargement of cylinder diameter brings with it increased constructional difficulties, and a greater liability to breakdown.

Turning now to the particular features of the Diesel engine itself, Carnot enunciated the conditions required for a perfect heat engine, and Diesel propounded a scheme which to a certain degree met the Carnot conditions. The original cycle has become modified to that now adopted, which may therefore be claimed to be the nearest to the Carnot cycle which present day practical limits admit.

The heat efficiency of the Diesel engine, though far from perfect, is still much better than that of any other heat engine, as is readily seen from the fuel consumption, which is 0·44 lb. of fuel oil per B.H.P. per hour. The fuel consumption is also low at partial loads, viz. :—¾ load 0·45 lb., ½ load 0·47 lb., and ¼ load 0·62 lb. per B.H.P.-hour.

These are not records, but everyday figures, and are for engines of quite moderate size. With larger engines the fuel consumption per H.P. is rather lower, but increase of size does not give anything like the improvement in fuel consumption that occurs with steam engines. This is a point to be remembered when fixing the size of engine to be adopted in a station. With steam plants the size of engine should be kept up, whilst with internal combustion engines the size within certain limits can with advantage be kept down.

Owing to the high economy at light loads it is often found distinctly advantageous to run a Diesel engine in preference to using a storage battery.

The oil generally used is residual petroleum, *i.e.*, the residue left from petroleum after the lighter oils have been distilled off. The increased demand for petrol will certainly tend to increase the further supply of residue, whilst the opening up of new oil wells in various parts of the world is steadily increasing the oil supplies. Not only is residual petroleum used for Diesel engines, but residue shale oil and gas works tar oil are now much used.

The fuel oil used can be almost any of the fuel oils which are used for boiler firing, and a wide variety of oils can be used with no alteration of the engine, this being probably explained by the fact that a pulveriser which will sufficiently pulverise a thick, viscous oil can easily pulverise the thinner oils. The use of oil fuel carries with it certain advantages in the way of ease of handling and of cleanliness. With coal it is difficult to avoid dust, and this must be particularly objectionable in the case of steam plant where the engines are carried on the boilers, thus placing a considerable quantity of moving machinery in the neighbourhood of the coal.

With oil there are no ashes to cart away, and thus handling of gritty materials is entirely eliminated. Usually the oil is pumped from an outside storage tank to the small tanks near the engines.

The question may naturally be asked whether Diesel engines are suitable for long periods of continuous running. In reply to this, the following instance may be quoted.

At the Birkdale electricity works a Mirrlees-Diesel was put down a little over four years ago. The station engineer recently made a return, which showed that the engine had on the average worked 23¾ hours out of every 24 hours throughout the four years, or an average stoppage of about 1¼ hours each Sunday.

Numerous cases could be given of large savings effected, but the figures already given substantially prove this, and are, perhaps, more appropriate for a paper of this kind.

Diesel engines of the Mirrlees make have been fitted on board many warships and first-class cruisers, for driving dynamos; also some have been used for boat propulsion. It might be of interest to mention that the first Diesel engine made in Great Britain was a Mirrlees-Diesel engine, and was made over 14 years ago, consequently the present Mirrlees-Diesel engines represent quite a long experience; and the present appreciation of this engine is not a temporary boom, but is based on substantial experience.

TELESCOPIC METAL MASTS.

In the Komet type of telescopic metal poles* use is made of a series of concentric steel tubes able to slide one into the other like the tubes of a telescope. Any or all of the sections can be run up, but it is automatically arranged that the inner (smallest) tube goes up first, the next larger then following, and so on; no tube can rise till the next smaller one is fully extended. The tubes are each strengthened by three steel rings (A, B, C, A′, B′, C′, &c., fig. 1), which further serve the purpose of holding each tube concentric with the one beneath it (A, B, A′, B′, &c.) and of interlocking with the flange (B, B′, &c.) on the tube above (C, C′, &c.).

The actual raising device consists of a flexible band of steel S S, of thickness varying with its width (and usually ranging from 2 to 8 mm.), provided with shoulders along its length equal to the distances between A′ A″, &c. (fig. 1) when the mast is fully

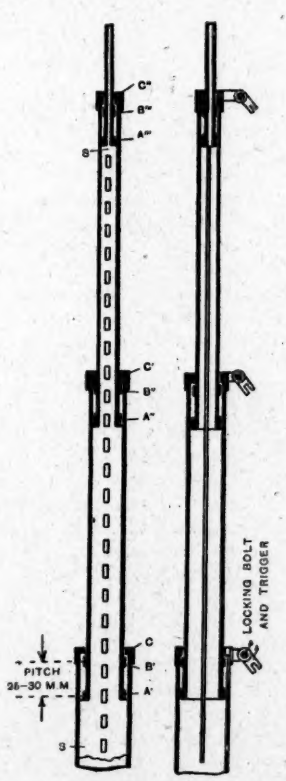


Fig. 1.

extended. This band fits inside each tube it penetrates, with no more than a mechanical clearance; when the mast is lowered, it is stored on a drum D (fig. 2), being then fed up as required by the toothed winched drums *d d′*. The drum *d* carries teeth which engage with rectangular slots in S S and suitable recesses in *d′*.

The top of each tube is split for a short distance down its length, and the collars C, C′ can be tightened by a double-threaded bolt to which is attached a projecting lever or trigger (see fig. 1). As each section of the mast, from the centre outwards, is fully extended, the next is automatically released, and, on its commencing to rise, its clasping trigger engages with a stationary pin; the double-threaded locking bolt is thus given a quarter turn, tightly clamping the fresh section to the one last erected.

The masts are generally circular, but may be square in section; in the first case, the elevating band is placed diametrically within the tubes; in the second, diagonally. Any desired temporary fittings

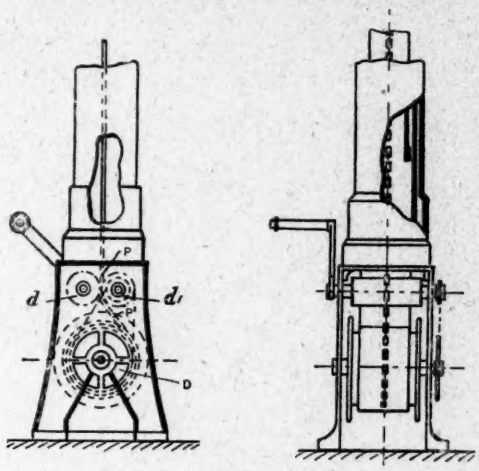


Fig. 2.

may be secured to the mast as its sections are elevated, and any permanent attachment may be used which will not interfere with complete "nesting" of the sections.

The weight of a conical mast of 25 m. (82 ft.) maximum height is about 120 kg. (265 lb.), while a pyramidal mast capable of extension to 10 m. (33 ft.) height and able to carry four observers (for military manœuvres, &c.) weighs 110 kg. (242 lb.). For "wireless" work a special mast capable of extension to 70 m. (230 ft.) has been made; this can be raised by four or five men in 25 minutes.

In the writer's opinion, the weakness of this system lies in the very great stresses set up in a steel band by winding it round such a comparatively small drum as D (fig. 2) must necessarily be.

Assuming the yield stress of the steel to be 17 tons/sq. in., and the ultimate strength to be 28 tons/sq. in., the drum diameter, in order that the skin stress due to bending may not exceed—(*a*) elastic limit; (*b*) 7 tons/sq. in. (f.s. of 4 on ultimate strength) must be, respectively, 610 cm. or 1,480 cm.—both of which dimensions are here impracticable.

It is clear that the band might easily be bent at P P′ (fig. 2) to a yet smaller radius than that of D, and, in any case, it seems to be impossible to avoid stressing a considerable length of the band S S far beyond its elastic limit. The mechanical properties of the metal would thus be seriously deteriorated. The band would receive a permanent curved "set," most of which would be forcibly removed every time the mast was erected. Apart from the great "fatigue" set up in the metal by frequently removing the "set," the band would take advantage of the small clearance necessarily allowed between its width and the internal diameter (or diagonal) of the tubes, to retain a certain amount of sag within the latter. The frictional resistance to the elevation of the masts should, therefore, be excessive, and one would expect serious scoring of the internal surface of the tubes. The increased clearance thus formed would aggravate the trouble.—R. E. N.

* See *Zeitschrift des Vereins deutsches Ing.*, October 22nd, 1910; also *Le Génie Civil*, 1911, page 102.

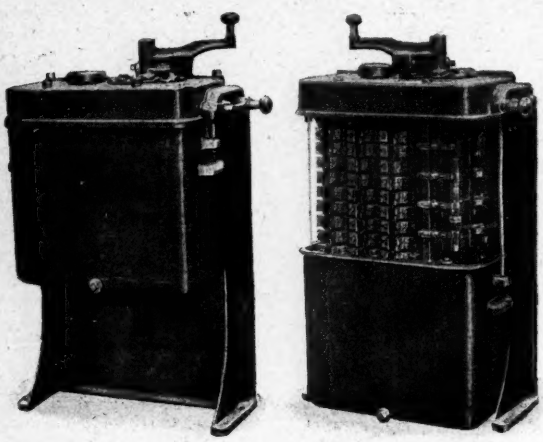
NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Reversing Controller for Induction Motors.

Messrs. Dick, Kerr & Co., Ltd., of Abchurch Yard, E.C., have recently introduced a new type of contactor controller, with a view to avoiding entirely the use of contacts rubbing on a slowly-moving drum for the make and break of currents, thereby ensuring that, however severe and exacting the conditions may be, the maintenance shall be extremely low. The contactor system gives a quick break and make, and maintains the surfaces smooth and clean, and at the same time has a minimum of wear on the contacts.

It will be seen from fig. 3 (p. 372) that there is a fixed frame on which are mounted the spindles A 1, carrying movable arms A 2, to which are fixed contacts A 3, each spindle carrying the number of arms with contacts corresponding with the steps of the rotor resistance, of which there are usually nine, with one step full resistance. These arms A 2 have a rotating movement on the spindle and also a small lateral movement, the combination of these movements ensuring that the contact pieces shall approach one another (when making circuit) at such an angle as to ensure a good wiping-action contact on the fixed contacts B 1.

Each of the movable contact pieces A 3 is held extended to the left by means of a spring, the spring movement being limited by blocks A 5. This addition ensures that in each case, when contact is made between the two contact pieces A 3 and B 1, any wear or unevenness of alignment relative to one another will not cause



Figs. 1 and 2.—Dick, Kerr Reversing Controller for Induction Motors, Closed and Open.

sparking, as in the closed position perfect contact is made against the full compression of this spring. Fig. 4 shows one of these movable contacts on a larger scale.

It will be seen from fig. 3 that a main operating pillar C is actuated by means of the controller handle, and carries a number of cams, each cam being appropriated by one of the movable cradles A 4, on which are pivoted the movable contact arms A 2.

In addition to this, the operating pillar has a cam E (see fig. 5), with a recess into which projects a roller F 3.

The first operation of the handle moves the cam E, closing the stator circuits. At this point the motor is connected to the line with all resistance in the motor circuit.

The next and following notches actuate the movable contacts in turn to make contact with the fixed contact pieces. An automatic

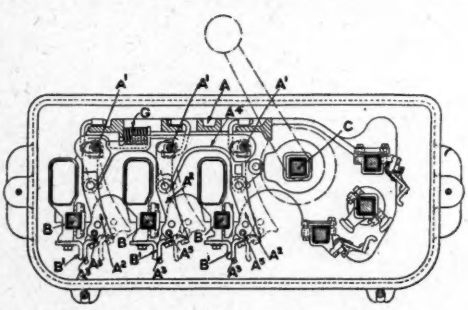


Fig. 3.—Plan of Controller Mechanism.

notching device is also attached to the handle, which prevents the operator from moving forward more than one notch at a time. The time automatically allowed between the notches permits the motor to accelerate the requisite amount before it is possible to pass to the next notch.

When it is desired to stop the motor, the controller handle can be brought rapidly to the "off" position, the whole of the

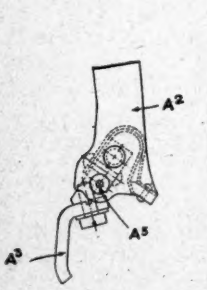


Fig. 4.—Detail of Movable Contact.

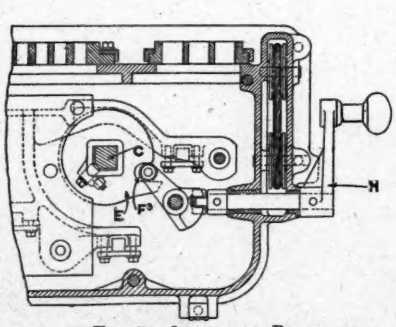


Fig. 5.—Operating Pillar and Reversing Handle.

speeding-up action being reversed, and the stator connection being broken last.

For starting-up the motor in the opposite direction the handle H is brought into operation, the movement of which raises or lowers the reversing drum, so that the stator connections are reversed.

The reversing handle is locked in position by the first movement of the controller handle; also the controller handle is locked by the reversing handle in any intermediate position of the latter.

The casing of the controller moves vertically up and down in guides, the whole of the weight, including that of the oil, being taken by a counterweight.

The whole of the current-carrying parts are immersed in oil, and the lowering of the controller case, which contains the oil, leaves the whole of the contacts exposed and at a convenient height for inspection or repair.

These controllers are usually supplied with 10 positions in either direction, and, although this number is rather less than is usually considered necessary in a drum type of controller, it has been found in actual practice that a much smoother acceleration is obtained than is possible with the older type.

The controllers can be supplied in two forms—for three and two-phase wound rotors; both can be used for either balanced or unbalanced regulation.

The average dimensions are 5 ft. high × 2 ft. 7 in. wide. The operating handle is at the top, as in the tramway type of controller, and the reversing handle on the right-hand side.

DEFECTS AFTER THE COMPLETION OF WORKS.

[from a legal contributor.]

When does the liability of a contractor come to an end? Assume that he enters upon the job and does the work to the satisfaction of the engineer, as the case may be; can he then wash his hands of the whole business, and disclaim all further responsibility?

Much depends, of course, upon the terms of the engineering contract. It may contain a clause which renders the engineer's approval of the work final and binding between the parties, or it may not. Thus the decision of the engineer may be subject to review in accordance with the arbitration clause of the contract. Again, there may or may not be a maintenance clause imposing liability upon the contractor to maintain the work even after the final certificate has been granted.

With a view to testing and ascertaining the duration of a contractor's liability, let us take a perfectly simple case. Assume there is an ordinary contract by which the contractor must do the work in accordance with a specification drawn up by an engineer. The work and materials are to be approved by the engineer; the contractor does the work; the whole job is passed by the engineer; and the final certificate is issued, and payment of the final instalment of the contract price is made. Some time later, foundations begin to give way and damage is done to the extent that a great part of the superstructure is damaged and has to be renewed. Who is liable?

Apart from the terms of the contract, it is manifest that the contractor could not by any possibility be held responsible for defects arising in the course of time from wear and tear. But if there is a structural defect which ought to have been detected and put right when the works were in hand, it is conceived that the contractor remains liable for that.

The time at which the defects become apparent has a material bearing upon the question of liability. Thus, a breakdown 10 years after completion may be due to ordinary wear and tear; while if the same mishap were to occur within a month of the contractor handing over the work as complete, it would require very strong evidence to show that he was not at fault. It is impossible to lay down a general rule by which the liability of the contractor can be ascertained. The time; the nature of the defect; the kind of use to which the work is put—all these things are matters which the Court would have to consider in arriving at a decision.

The following points have been clearly decided:—(1) That mere acceptance of the works by the employer is no answer to a claim by the employer in respect of defective work; and (2) if there is a settlement between employer and contractor, it is a question of fact whether that settlement is intended to cover future as well as past claims for damages. In Jones *v.* Bright, 1829, 5 Bing. 533, the plaintiff bought copper sheathing from the defendant, and used the same upon a ship. The plaintiff sent the ship on a voyage; but the copper instead of lasting four or five years,

as usual, became corroded and useless after four or five months. It was held that the plaintiff was entitled to recover damages, although he accepted the ship.

Circumstances may arise, however, in which the certificate of an architect or engineer may prevent the employer making a claim for defects. Thus it was decided in the case of Lord Bateman *v.* Thompson, 1875, 2. H.B.C. 23, that where a certificate of completion and satisfaction by the employer's architect is made conclusive and is given, the employer has no right of action against the builder for defects subsequently discovered, except within the time and upon the terms specially stipulated by the contract. The facts of that case were somewhat peculiar. The work done by the contractor was disgraceful, but a period of six years elapsed between the completion of the work and the beginning of the action. The architect, however, had approved the work and materials, and had duly certified the amounts due under the contract from time to time. Lord Coleridge, C.J., clearly enunciated the principle which led the Court to say that an action would not lie against the contractors. He said:—"This is the ordinary case, not of an arbitration, but of the employer having made the certificate of the architect binding in certain cases against himself, and still more of his having made his own expression of satisfaction binding against himself. And having received the one and having expressed the other, he cannot now say that he did not receive the one or did not express the other. It may seem a hard thing to say, but the answer is the answer which Mr. Justice Wills gave in the case of Goodyear *v.* Mayor of Weymouth, 1865, 35 L.J.C.P. 12, that if you employ an architect who does not know his business, and who certifies that he is satisfied when he ought not to express satisfaction, you must be bound by his mistake. It is not in the least an answer to say that you have employed an architect who does not know his work, and if people employ architects who do not know their work, and who lead them into mistakes, and place contractors bound hand and foot into the hands of such persons, and such persons either pass bad work, or, as it appears in this case, actually direct bad work, they cannot afterwards in equity or fairness turn round on the contractor, and say, 'Now I will bring an action for damage that I have sustained, because you have fulfilled the direct instructions of a man whose authority I made binding upon you; but as he did not know what he was about, and because I have suffered damage from an authority which I myself made despotic over you, I now turn round upon you to make you liable for the damage I have sustained.'"

In one case (Sharp *v.* The Great Western Railway, 1841, 11, L. J. Ex. 17) the plaintiffs had manufactured certain locomotive engines under the following contract:—"Each engine and tender to be subject to a performance of a distance of 1,000 miles with proper loads, during which trial Messrs. S. & Co. (the plaintiffs) are to be liable for any breakages which may occur, if arising from defective materials or workmanship; but they are not to be responsible for, nor liable to, the repair of any breakage or damage whether resulting from collision, neglect or mismanagement of any of the company's servants, or any other circumstances, save and except defective materials or workmanship. The performance to which each engine is to be subjected to take place within one month from the day on which the engine is reported ready to start; in default of which Messrs. S. & Co. shall forthwith be released from any responsibility in respect of the said engine; the balance to be paid on the satisfactory completion of the trial, and release of Messrs. S. & Co. from further responsibility in respect of such engine." It was also agreed that the fireboxes should be made of copper, of the thickness of $\frac{7}{16}$ in., and they were accordingly so made, and that the best materials and workmanship were to be used. The engines performed the distance of 1,000 miles within the month of trial, but nine months afterwards the fire-boxes of one of them burst, when it was discovered that the copper had been considerably reduced in thickness. In an action against the defendants for the balance due from them, it was held that they could not give evidence of an inherent defect in the copper, no fraud being alleged, since, by the terms of the contract the month's trial, if satisfactory, was to release the defendants from all responsibility in respect of bad materials and bad workmanship.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Arcana Imperii.

A few days ago I happened to be a passenger on a certain city tramcar, and could not help but notice the way the car was stopped and kept waiting for so dignified an official as the chairman of the undertaking. The car had got some 30 to 40 yards from the last *official* stopping place (which was not one of the "Cars stop by request"), when a person came out of an hotel, hallooing and brandishing his arms for the car to stop, which it did when the conductor saw who the person was.

A fellow-passenger remarked, "It's the chairman of the trams," and several other remarks I heard, which were, to say the least, not at all complimentary to the one under discussion.

This tramway system is supposed not to pay, and I think there is a special rate in the city to make up for the working deficiency. Perhaps they would be a benefit to the ratepayers, if punctuality and non-favouritism were demonstrated to those in charge of a car by the officials, and especially by so high an official as their chairman.

Double-Gloucester.

Labour Troubles.

Under this heading there has recently been proceeding in your columns a correspondence arising out of several leaders which have appeared on the same subject. The attitude evinced in the latter has been one of undisguised antagonism to the workers, and their position has been totally ignored. As a reader of the REVIEW for several years, I have observed that the invariable attitude taken by it upon any labour question is that of urging the claim of the employer to squeeze every possible ounce of profit out of the workers. The only point of view it appreciates is that of the employers. This, of course, is only natural. It represents the views, in general, of manufacturers, with whose interests those of the paper are closely bound, and it takes the view of these things which is dictated by its own interests. Be it said to its credit, however, that it makes no claim to impartiality.

This, however, cannot be said of your correspondent, Mr. Wyatt, who prefaces two columns of mostly irrelevant remarks anent the subject, written in a spirit of hostility to the working class, by an avowal of his impartiality and of his sympathy towards them. Sympathy the working class are always offered in unstinting quantities; where they ask for anything more concrete they get batons and bullets.

The sophistries of this gentlemen hardly call for reply. He totally ignores the facts of the situation. This is the position, and if Mr. Wyatt is interested in these matters, he will leave the quack remedies of German and any other bureaucracy and study it.

Labour applied to natural resources is the sole source of wealth. Nothing possessed of economic value can be produced save by the application of human energies, mental and physical, to the raw material of nature. Society is divided roughly into two classes—those who own the raw material of nature (in which I include, for the present, such things as machinery, railways, &c., which are the medium between man and nature) and those who do not. The latter class, possessing no property, in order to live must obtain permission from the owners to work. In other words, they must sell the only thing they possess, namely, their power to labour. The ownership of the means of life constitutes one small section of the community, the masters of the remainder.

All wealth, I repeat, is produced by the application of human energies to the raw materials provided by nature, but those who apply this energy, the workers, when they have produced wealth, do not own it. It is taken by the people who own the means of production.

Those who produce, those upon whose exertions society is founded, and by whose exertions its continued existence

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alone is possible, do not own the wealth they have produced. Therefore they are poor. They produce all food, they have the worst; they build palaces, and live in hovels; they construct motor-cars, and walk; they make fine clothing, and wear shoddy; they make boots, and have scarcely a pair to their own feet. In return for their labour power they receive, on the average, a bare subsistence rate, called their wages.

These are facts within the cognizance of all of us; the cause is:—That the means of life, which are essential to everyone of us, are owned by a few members of the community.

The workers do not completely realise this yet, but they do realise the contrast between their lot and that of their masters. Their everyday experience tells them that their condition tends to become worse, and that the insecurity of their existence becomes more pronounced year by year. They are learning their power, and the recent strikes are a revolt against their conditions.

Mr. Wyatt may talk glibly about the "unenlightened multitude," but it is the "unenlightened multitude" that makes the mare to go; let them stop work, and we soon see who are the essential factors in modern production.

He reproaches a previous correspondent with "waving aloft the flaming torch of class hatred and enmity." With the unprovoked (see *Manchester Guardian*, &c.) Liverpool shambles yet fresh in the mind; with the spectacle of the country patrolled by the British Army to protect the property, and intimidate the striking employés, of the railway companies; with the remembrance of how the Press of the country, almost without exception, shrieked hysterically for the maintenance of "law and order," recommending the copious administration of grape-shot; this accusation of exciting class hatred is, to say the least, distinctly ingenious.

W. J. G.

Liberty is a glorious thing,
A spendid demonstration of
Unity, Loyalty and Solidarity.

No doubt we can all subscribe our admiration to the above sentiments expressed by your correspondent "Labour."

But has Trade Unionism these expressed sentiments as its basis? Decidedly not. It is a most pernicious form of individualism.

The Trade Unionist, in seeking to free himself from the economic forces that everyone has to contend with, loses his freedom and becomes a slave to his union, the tool of a set of agitators, who have themselves broken the economic bond by posing as liberators, demanding, of course, pay from their slaves.

It is above question that the leaders of these strikes, the leaders mind, for these are the men that other misguided men are following, are not men (to put it exceedingly mildly) most of us would care to acknowledge in that capacity.

As for unity, loyalty and solidarity, Trade Unionism prostitutes these virtues. To whom is the Trade Unionist united other than to his particular friends, *i.e.*, men in his own trade *and members* of his union? Do men of the stamp of Ben Tillett impersonate the Prometheus, the enlightened democracy, your correspondent, assuming the prophetic air, speaks of? If so, may Heaven save us from such loyalty and solidarity!

Now, let me give you the straight tip, Mr. "Labour." We all want unity, liberty and solidarity, and, what is more, I feel sure that our country means to maintain it inviolate, as far as it lies in its power.

But, Mr. Editor, I think you will agree that there is something to be said in mitigation of these unfortunate occurrences. The growth of Trade Unionism, however ineffective as an objective force, has to be reckoned with. It is a force that has grown for some purpose, and, like all evils, must be met fairly and squarely. I must admit, however, that I do not feel competent to go into this matter, because it seems to me that the remedy lies in a direction which strikes a blow at our democratic constitution, and for a weak individual such as myself to offer suggestions of so drastic a nature, would be unwise.

But I might just say that Mr. A. W. Wyatt, who contributed to your "Correspondence" columns of August 18th, makes a remark which I believe has a very important bearing on this matter. He says, "The day of the small employer who could take an individual interest in each of his employés is past, and big combines, without a soul or conscience—(I have heard them described as being without a body to kick, or a soul to save—T. G.)—have taken his place." Yes, the loss of this intimacy between employer and employé accounts for a good deal of the trouble.

Yet, I am sanguine enough to believe that there are still a number of employers who have not lost all respect for their employés. Also, that there are still a large number of the latter, who realise that the poverty of the employer to deal with the economic situation is as great, nay, even greater than his own. Strikes are undoubtedly a national calamity, and it does seem a pity that some courageous soul is not forthcoming to stem the torrent of revolution and to neutralise the wild tirade of the agitator.

It is useless for us workers to allow our dissatisfaction to get the upper hand of us in this way, by the fomentations of men who are mostly non-workers. For we must remember that even those who are better off, from a monetary point of view, have their difficulties to meet and deal with. We must remember that we all are members of one great Empire, and that to become so sharply divided against ourselves is a serious menace to our future welfare.

United we stand;
Divided we fall.

And we stand or fall all together. **T. Gaunt.**

[Since this section of the Review was closed, we have received other communications which we do not regard as useful contributions to this correspondence; but as both sides have now had a sufficient opportunity for expressing their opinions, we do not propose to continue the present discussion. As to whether the question is one coming within the province of a journal whose *raison d'être* is to watch all matters which have a bearing upon electrical engineering industry, we have very definite convictions. Further, while every reader knows that we have always allowed both sides full and equal opportunity for considering the merits of any question, we decline to publish useless tirades or personal abuse. If writers will bear this fact in mind it will save them some disappointment.—Eds. E.R.]

Publicity Literature.

The adverse criticism on the literature published by the supply companies and corporations, is, to my mind, somewhat unwarranted.

Possibly this advertising matter is not all that could be desired, but one must take into consideration the difficulties of the proposition. Here is what we may term a new power, about which the general public know but very little. The question is, where is the line to be drawn between the adoption of popular language and technical language? And to what extent is the suggested educative policy to be applied? The latter is the most important point raised in the article.

Your correspondent looks forward to a time when some elementary work will be produced on electrical matters. He, however, overlooks the fact that, generally speaking, the prospective consumer is not interested in electricity, beyond its application to his needs. Any attempt to burden him with voluminous detailed information and instructive matter, even though it may be "elementary," will result in an impression that the adoption of electricity involves a great deal of trouble. He does not want to know all about series burning, metallic filament lamps and transformers. The question is, how much does it cost to use electric light? What saving is effected? What advantage does it possess over other methods of illumination? All these and other questions can be answered without recourse to technical language.

The constant driving home of the merits of electric light through the medium of the Press and attractive circulars, &c., will, sooner or later, make a favourable impression and produce inquiries. It is then the duty of the canvasser to turn these inquiries into business. He has the advantage of being able to study each individual case, and apply suitable arguments. When he meets a prospective customer of

an inquiring turn of mind—then, and then only, is it safe to go into the technical side of the question.

It is not so much the quality of the advertising matter that is at fault, as the limited amount of advertising and circularising that is being done. For instance, I have lived in a 12 roomed house for nine years, and so far have not been approached by the Corporation electricity works either by letter, circular or personal call. I am sure, however, that the time will come, as the efforts of the Publicity Committee are progressive, and they have already done much to further the use of electricity.

A. J. Greenly.

London, E.C., *September 5th*, 1911.

THE OFFICE AS A WORKSHOP.

By EDWARD G. FIEGEHEN, A.M.I.Mech.E.

In all engineering establishments we may classify the employés under two main headings—workmen and staff.

During recent years the detailed organisation of our workshops has received much attention—with the result that every facility and encouragement is now given to the workmen to maintain the high rate of production shown to be possible under favourable and systematic conditions of working.

The new school recognises the indispensability, in addition to purely mechanical facilities, of such items as adequate lighting, efficient ventilation and heating, and a prompt supply of materials and instructions to secure the best results.

The improvements in the construction of machine tools and the introduction of improved tool steels, have, of course, contributed largely to recent progress, but with this factor we are not at the moment concerned.

The benefits arising from the reorganisation of our workshops, we may add, has been shared fairly equally by master and man.

On examining the progress made in the offices during the same period, we find certainly a noticeable increase in the number of labour-saving devices in use, but on all sides a sad lack of intelligent organisation designed in a similar manner to obtain the best possible results from each employé, and this in spite of the fact that the average rate of pay is here somewhat higher, and that the staff have precisely the same human characteristics as their fellows in the shops, the sedentary nature of their occupation making them if anything more susceptible to their surrounding conditions.

Many firms who possess the most up-to-date workshops are still content with office buildings, the many defects of which are not by any means conducive to economy and efficiency, and, in such cases, one is tempted to suggest that the manager who has so successfully applied his knowledge of the conditions favourable to maximum production on the workman's part, should now turn his attention to the amelioration of the conditions under which the clerk and draughtsman work.

He will find in many cases that the lighting is defective either in quantity or direction, and consequently at the end of the day many of the men are suffering more or less from headache due to eye strain.

To a draughtsman especially, the appropriate direction of the light is most important, and to be compelled to work in an unfavourable light is a serious discouragement to the most industrious man.

In the shops, owing to their height and floor area, special arrangements for ventilation are rarely needed in this country, although certain systems of warming shops by hot air perform this additional function.

In the offices, on the other hand, the limited air-space per man presents a clear space for adequate ventilation, and yet we rarely find any provision of the kind.

Many manufacturing engineers' "offices" are merely spaces partitioned off in a temporary manner from the works, and, in the natural desire to avoid encroaching unduly upon the "productive area," the floor space allotted to the staff is often merely sufficient to secure what may be termed "mechanical clearance."

An increase in the number of workmen employed may, of necessity, be accompanied by the erection of additional bays, but the accommodation in the office will generally remain unaltered, in spite of certain additions to the staff.

Let us put the case for a proper air supply in a simple manner—it is well known that the human body is comparable to a steam engine and boiler, inasmuch as each is a prime mover converting chemical energy into mechanical work; deprive the boiler furnace of the necessary supply of oxygen, and the steam pressure gradually falls and the speed and power of the engine diminish.

Bearing this in mind, it is easy to realise that reasonably fresh air is in very truth the "working fluid" of the clerk, and that if, after a few hours in a stuffy office, the clerks—even the most industrious of them—involuntarily yawn and feel limp and lazy, it is a clear indication that the energy supply is throttled, and we cannot blame them for the natural impulse to escape to more normal conditions as soon as the whistle blows.

After all, at the present time, we are open to the indictment of exploiting our brains at the expense of our bodies, and until we realise that the efficiency of the former is inseparably connected with the health of the latter, we shall continue to pay the penalty exacted by Nature.

The writer cannot recall an engineer's office where a really workable system of *air changing* (as distinct from *air stirring*) is in use, but remembers only too vividly some in which, after the first hour or two, it required a distinct and continued effort of the will to resist the tendency to fall asleep.

Many private offices, occupied by heads of departments and other officials, are merely tiny spaces partitioned off from larger areas. In the lower part of these "boxes" (for they deserve no better name) the heavy carbon dioxide accumulates until it reaches the level of the victim's face, and then the trouble commences.

The writer feels certain that if an impartial and searching test could be arranged to verify such complaints, and to ascertain the improved output attainable, merely as the result of the introduction of efficient ventilation, a proper system of fresh air supply would be installed in all progressive engineers' offices, merely as a continuation of their successful workshops policy and from similar purely commercial considerations.

Another essential service that is, as a rule, very imperfectly performed in offices is that of heating; but although insufficient or irregular heating certainly involves discomfort, it does not affect the output so seriously as defective air supply, which latter directly reduces the vitality of the workers, as we have seen above.

A minor distraction that cannot fail to reduce the output is that of *noise*. Much of this is unavoidable, and passes, in fact, unnoticed; but it is, indeed, strange that brain-workers have tolerated for so long the harsh insistent rattle of the telephone call-bell. It seems absurd that to an instrument, never removed more than a few feet from its user, an alarm should be fitted with a range of perhaps 50 yards, and yet the type survives. It is indeed a matter for conjecture whether the introduction of the telephone into our offices, under present conditions, is on the whole a benefit or otherwise. At any rate, it is certain that in any scheme of office reorganisation the relegation of this instrument to its legitimate sphere should form the subject of most careful investigation. At the present time its tendency is to dominate all grades, breaking in disastrously upon calculations and discussions, and frequently wasting the time of other workers besides the speaker.

Possibly the employment of a smart and resourceful official, comparable to a "press censor" and through whom the bulk of the messages would pass, would prove conducive

to the increased efficiency of the erstwhile "slaves of the bell"—in fact, a very similar process of selection is found necessary in many merchants' offices to protect the buyer from the unwelcome importunities of travellers.

It is an axiom of works management that each worker should be provided with a sufficiently good supply of material and instructions to keep him continuously engaged, and it is the foreman's duty to anticipate his prospective requirements, and to arrange to the best advantage the sequence of his operations.

The application of the same principle in the office would effect in many cases a vast improvement, not only in the quality of the work, but by actually reducing the energy expended upon it. For example, the daily work of many a highly-paid member of the staff cannot be seriously commenced until he receives his share of the morning's letters, which, however, have first to pass through the hands of the general manager. Should this gentleman turn up later than usual, the work of this department at least, is disorganised and delayed, and either important work has to be rushed to ensure its completion before closing time, or overtime, with all its disadvantages and hardships, has to be ordered.

A moment's reflection will show clearly that the activity of a large section of the technical office staff is determined almost exclusively by the nature of the morning's letters, whilst the necessity for catching a desired collection or foreign mail will often restrict the time available for the compilation of the desired information.

Under existing arrangements the draughtsmen, clerks and typists engaged in this department arrive at 8.30 or 9 a.m. (when they are least required), whilst the manager, who usually distributes the letters and inquiries and formulates in outline the day's programme to the heads of departments, is yet on his way to business.

Now, to apply the principles of sound organisation to this problem, it is clear that the manager and the heads of departments ought really to be the first arrivals at the office, an early delivery of letters being arranged.

An uninterrupted hour's work in advance of general office hours would enable the necessary instructions, based upon the correspondence, to be given to each responsible official, so that when the rank and file arrive they can at once be employed at full capacity. Thus, with an adequate and willing staff, "overtime" need only be resorted to in an exceptional emergency, and no additional burden need be laid on those in authority.

In the shops it is held to be distinctly bad management to "break into" a man's job for the sake of some triviality, in fact, many foremen blankly refuse to do so except under great pressure.

The manager of a concern is, in fact, a workman taking a salary many times greater than a journeyman's wage, and yet we find many of his class who allow their time to be wastefully cut up.

Medical men fix definite hours of consultation to suit the convenience of both their patients and themselves, and the arrangement entails no hardship upon either party.

A somewhat similar arrangement would give the manager ample time for his important work, interviews, &c., free from interruption, whilst the knowledge that he can be approached without hesitation at definite hours would save many fruitless journeys on the part of others.

Special circumstances will, of course, at all times override such rules, and rightly so; but very little reflection will show the evils of the prevalent lack of system in this direction.

In conclusion, we have only to accustom ourselves to looking upon the office *as a workshop* to realise that many of the cardinal principles of success determined in connection with the actual manufacturing departments can be logically applied here also.

We may perhaps never be able to offer to the efficient clerk or draughtsman inducements to greater activity analogous to the bonus systems of the workshops, but we can, and should, keep him continuously supplied with appropriate work under favourable conditions, and thus afford the ambitious ones a fair chance of qualifying for promotion.

THE CHARGING OF, AND FOR, IGNITION BATTERIES OF PETROL ENGINES.

By WALTER E. ROGERS, A.M.I.E.E.

In the above title, the "of" refers to the electrochemical process, while the "for" is pecuniary only.

The advent of the motor-car, which is being followed by the flying machine, has flooded this country with a host of small secondary batteries, which, of course, require recharging at frequent intervals.

In these days when so much is said, and more written, about day load for the electricity works all over the world, it is a matter of surprise to me to find that whilst our chiefs are inserting advertisements for representatives to push the installation of cooking and heating appliances, &c., little or no attention is being bestowed upon a class of small day load, which may, as the writer hopes to show, be cultivated actually at the generating station with practically no capital outlay for mains, sub-stations, &c.

One of my late chiefs did everything to discourage cells being sent to the works to be re-charged, by charging for them at an exorbitant and prohibitive rate, because, he said, they were a bother. Yet he would go many miles to secure a 5-H.P. motor consumer, and would be very sarcastic to the mains superintendent over delay in connecting a ¼-H.P. potato peeling machine, which entailed a capital outlay of, perhaps, £10, and a revenue of a few shillings per year.

Looking round the works where the motorist is catered for, more or less, what do we find? In the meter room, or shift engineer's office, there is a piece of acid-eaten and fly-besprinkled flexible, a corroded lampholder and, perhaps, one small celluloid box being charged, price 6d.

Yet, again, I find a board equipped with batten lampholders and, sometimes, a quite unnecessary ampere-hour meter. I say unnecessary, because it is pretty well known that at 100 volts a 32-C.P. carbon-filament lamp takes 1 ampere approximately, and a 16-C.P. ½ ampere. At higher voltages the current is proportionately lower for the same candle-power. An ammeter may be a useful adjunct to the charging outfit, but the only instrument really necessary is a portable voltmeter, reading 0 to 5, or, perhaps, 10 volts.

In some provincial towns where I have resided, every motor engineer, garage, cycle repairer, plumber, &c., has had his own charging equipment supplied from the street mains *via* the shop lighting, &c.; the local station man rejoicing in the fact that he was charging a number of accumulators through lighting meters—*i.e.*, he was obtaining 3d. or 4d. per unit for what might rightly be considered power load. This, of course, sounds very nice, and relieves the works of all trouble and the usual row which takes place when Alderman Grouser's old battery happens to have been put on charge the wrong way round, as is invariably done sooner or later. But it does not tend to popularise electricity when the local paper comes out with an account of the destructive fire which gutted Messrs. ——'s premises last night, caused by the fusing of electric wires, and the usual stock comments thereon. What really happens is that just as the electrician of the particular motor bodger is leaving in the evening, a 10-ampere-hour battery in a celluloid case is brought in to be charged by 9 a.m. to-morrow, as the owner wants to start for Timbuctoo on his new "Roling Romper" at that hour. "So please give it a good charge." Our electrician places it on the wooden window ledge, where there are already three other similar batteries on charge adjacent to two tins of cycle oil, a curtain, and some dirty waste. To connect the battery, he takes a piece of wire, bare or insulated, it matters not, and twists it round a terminal, switches on, and bolts for his tea. Nothing happens at once, but after a time C^2R begins to make its presence felt at the terminal, which has the twist of wire round it. This is aided by the battery being on wrong way round. From this point it is not difficult to trace the sequence of events from the time the celluloid ignites to the arrival of the fire brigade and the fusing of electric wires, &c. Another place where the first spark actually occurs is where the brass screw of a terminal is actually burned, or more often, soldered into the lead; here corrosion frequently takes place, and the terminal

nut being too stiff for fingers, having learned that nuts should always be tight, we assist the coming fire by using a pair of pliers.

Since the occasional ignition of a celluloid battery appears inevitable, even when proper treatment is accorded, it being only a question of a sufficient number of cells passing through the individual's hands for one to be destroyed sooner or later, steps should be taken to minimise the damage when the conflagration has started. An old disused fire-place, provided there is a chimney, affords as convenient a charging station as can usually be found. Procure a lead-lined wooden tray, which, roughly speaking, should be fan-shaped. Place the fan-handle at the back of the fireplace, the tray being horizontally propped up in front on bricks; then, with ordinary care, no damage will be done to the surroundings when the flare-up comes.

The installation of a separate meter for charging secondary cells at every charging station throughout the town, in order that energy may be sold at power rate, is objectionable, whether your meters are purchased out of borrowed capital or according to the latest L.G.B. requirements, which are sound practice and finance. All I have written, of course, directly concerns the D.C. station only, but now that the mercury rectifier is a practical success in all but first cost, our A.C. friends may expect to hear some more about "fusing of electric wires." One station in London, with which I am acquainted, commences by posting up in a conspicuous place, where a person handing in a battery can read it, the following:—

NOTICE.

RECHARGING ACCUMULATORS.

Whilst every care is taken of batteries, the ——— cannot accept responsibility in regard to damage done, or defects arising in the course of recharging. The leaving of batteries for recharging is taken as an acceptance of this condition.

I have not copied the above as a sample of English, nor can I advise upon the strict legality thereof, but I give it simply to convey a hint to the unwary, as damage, either genuine or imagined, will undoubtedly arise when any number of batteries are dealt with.

For instance, say it is the switchboard attendant's duty to look after these cells. However much he knows about peroxide of lead, it is not right to expect that he can invariably sandwich the duties of synchronising an alternator, just as load is coming on, with connecting up a small battery correctly as regards polarity, time and hard usage having frequently obliterated all marking on the box. So that occasionally a mistake will be made, with disastrous results so far as the particular battery is concerned. It must also be remembered that quite a lot of the batteries brought in will be completely exhausted, as Mr. William Bayley, whose licence bears endorsement, knows nothing, and cares less, about 1·8 volts per cell as a minimum, beyond which he should not discharge.

The following is a method which has proved very convenient for recording and identifying cells, and which satisfactorily dealt with some 300 batteries of the ignition type between the end of June, 1910, and the end of February, 1911.

The receipts during the above period were of the order of £5; the pecuniary charge was 4d. to 6d., according apparently to no system whatever, but groundless agreements made by the ruling power with the customer, without any consideration having been bestowed upon the actual cost incurred on the part of the charging authority. Taking a case at random, I find a 4-volt 40-ampere-hour battery took 6 units to bring it up, the customer being charged 4d., whilst the total works cost in the above station was published at approximately 1d. per unit sold. Comment on my part would be superfluous.

A system of tokens proves very reliable. We may have a duplicate set numbered consecutively 1 to 50 or 100 as the case may be. The customer's token is simply a brass disk about the size of a half-penny, bearing the same number as the token which is attached to the battery when first brought in. The latter token should be composed of some acid-resisting material such as celluloid. Each token has a small hole near its periphery, so that when not in use it may be strung on a wire. The same hole serves as a convenient means whereby, with the aid of a piece of lead or composition fuse wire, the token may be readily attached to the battery. For connecting cells in series during charge I find soft fuse wire about 18 or 20 S.W.G. most convenient, as a momentary short-circuit in connecting up will do no harm.

I find that in dealing with the 300 cells referred to, about 1½ lb. of soft fuse wire have vanished; but as the value of this does not exceed about 2s., it does not constitute a serious matter.

Whilst touching upon the question of cost, it may be well to mention here that I have known of a standard price of 6d. per battery being fixed upon, irrespective of capacity, with a view of avoiding complaint and complication. Result: a certain customer came in one day with a battery in a beautiful box, which aroused my suspicions, and upon removing the lid I discovered seven cells in series, ranging in capacities from 10 to 40 ampere-hours each.

A method of charging, pecuniarily speaking, which I put forward for what it is worth, and which appears fair to all parties, is to have a fixed price per pound weight of cell when full of acid. Suppose the price is equal to the total cost of production per unit, including standing and all charges; we then catch our friend with his seven cells in one box, and everybody knows what it will cost to have such and such a battery recharged. No meter is required, but only a pair of scales. In support of charging for recharging cells at so much per lb. weight, be they in celluloid, glass, or wood boxes, I submit the following figures, taken from seven batteries, just as they have come in since I commenced to draft this article.

Number of batteries dealt with = 7.

Capacity	10	ampere-hours.	Weight	3 lb.	9 oz.
"	40	" "	"	9 lb.	1 oz.
"	10	" "	"	4 lb.	10 oz.
"	*25	" "	"	11 lb.	8 oz.
"	30	" "	"	7 lb.	2 oz.
"	*50	" "	"	14 lb.	4 oz.
"	*100	" "	"	23 lb.	8 oz.
Total	265		Total	= 73·5 lb.	say.

* Signifies in wood cases with carrying straps.

This gives us a mean weight per cell of 10·5 lb. All were 4-volt cells. If the price charged be equal to the total works cost as published, we should, taking the particular works I have cited, have obtained 10½d. per cell, whereas with the methods and system actually in vogue there, 5½d. only was obtained, including about 2 oz. of acid in one cell.

Again, I have stated that the receipts, based on the 4d. and 6d. arrangement, amounted to some £5 for 300 cells recharged. Had my system been in operation something like £13 would have been taken. I would give away the necessary water and acid required for topping or filling, and would have all cells filled before weighing, regardless of any message sent with the cells.

Turning now to the necessary equipment for recharging, I advise a lead-lined wooden tray, say, 3 ft. × 2 ft. by about 3 in. deep. Place transversely in this tray three wooden racks or gratings, each measuring 2 ft. × 1 ft. The gratings must be thoroughly painted with anti-sulphuric paint; each lath of which the gratings are composed should be 2 in. deep by 1 in. broad and spaced apart about 1 in. Fix the charging tray in some convenient position, where it is always under the eye of the man responsible, be he shift engineer or switchman.

On the wall behind the tray two boards should be fixed, each equipped with a charging resistance consisting of, and wired independently with, six lampholders and one switch. I say two boards, for if a number of cells arrive simultaneously they will vary in capacity and their requirements as to magnitude of charging current.

Having got to work and commenced to charge, one quickly discovers as gassing takes place, that the vents provided with many cells are totally inadequate, and unable to pass away the gases formed, it being frequently necessary or desirable to remove the filling plugs or stoppers; in doing so one or two of the said stoppers are apt to be dropped. It is for this reason that I have divided my wood rack or grating into three sub-racks, for each sub-rack can be lifted separately as required to recover the dropped stoppers. Also these wooden racks prevent the batteries on charge from standing in acid inadvertently spilled, thus protecting the

outer sheet-iron or wood containing-box and strap carrier which frequently embraces individual cells.

Quite 20 per cent. of the cells brought in will require topping. Here is a small difficulty, for not one cell in a hundred is designed to admit a hydrometer, or even to allow the use of a suction or pump hydrometer by which the electrolyte is drawn into a tube, thus providing sufficient vertical height to float the instrument for ascertaining the specific gravity of the liquid.

Again, many of the cells brought in in connection with portable lamps, &c., will have microscopic apertures for introducing acid or water. As very small glass funnels are difficult to obtain, probably we shall have to draw out a piece of $\frac{3}{4}$ in. or $\frac{5}{8}$ in. glass tube; with a little care and sufficient heat, one can manufacture a very useful little funnel. A glass syringe will answer the purpose; but as the plunger is usually packed with cotton, frequent repacking is required.

Much can be done by using the body or barrel of the syringe as a funnel, having previously withdrawn the piston. Owing to the difficulty in using a hydrometer, one can only guess whether water or acid is required to bring the electrolyte up to the proper level. When the cells are sufficiently transparent to permit a view of the plates, experience will guide one as to the advisability of topping with water or acid. For instance, generally speaking, if the positive plates appear eaten or crumbly near the surface of the electrolyte, use H_2O only. If the same plates appear unusually light in colour, H_2SO_4, specific gravity 1,200, may be used. These are by no means infallible rules, but the merest hints, gained through long experience.

Also I am told that the eye of experience can roughly estimate the density of acid by the speed with which a strip of litmus paper is acted on, but, candidly speaking, I can obtain no intelligible result with litmus paper. The rapidity with which a freshly cleaned or scraped piece of metal, such as brass, tarnishes under the influence of a splash of electrolyte, may be taken as a very rough guide to acidity. But here again experience alone will help.

REVIEWS.

The Calculus for Beginners. By J. W. Mercer, M.A. Cambridge University Press. Price 6s.

This work is intended primarily for young people—for boys who are, or will be, interested in the applications of the calculus to physics and engineering. With regard to this, the author makes some pertinent remarks in his Preface. He says, for instance, "I had much rather that a boy, confronted with a problem, should, after analysing it, be able to say, 'If I could differentiate (or integrate) this function of x, I could solve the problem,' than that he should be able to perform the operation without seeing its bearing on the problem." Again, "I believe that boys, especially on the science side of a school, could profitably begin the study of the subject at a much earlier age that is usual."

That a boy should understand a process before being able to work the process, seems reasonable; that he should be able to work a process before understanding it, is lamentable. Unfortunately, the calculus is just one of those subjects that a boy can work and use without understanding. He can learn in a very short time to differentiate and integrate the simpler functions, just as a parrot can learn to speak. For the operations involved depend simply on memory of mechanical detail, and not at all on the intelligence. One cannot help asking if it is wise to teach even the elements of the calculus to boys. Would it not be better to keep them at algebra and trigonometry, and thus give their minds a good soaking in ordinary mathematical principles—principles which have to do with stationary, inanimate quantities—rather than start them off, before they are developed, on principles that have to do with movement and life?

The experience of the reviewer gives, at any rate, a positive answer to these considerations. He has a large experience with boys undergoing a semi-physical, semi-engineering course of training, and he can assuredly say, as a result of this experience, that boys of 15 or 16 years of age are *incapable* of understanding the reasoning on which the calculus is based. Why this should be so is difficult to say. It seems to be one of the laws of nature for which there is no accounting. Perhaps there is a critical state of mind in youth, an age before which such principles as are involved in the calculus are incapable of assimilation, and after which the difficulty is removed or becomes less. That there *is* such a critical age, those who have wide experience in all classes of teaching will be inclined to agree.

The reviewer, then, is of the decided opinion that the calculus should not be taught until the age of 17 or 18 is reached. Any teaching before this age, no matter how clever and painstaking it be, will in the vast majority of cases lead to that machine-like non-understanding use of the subject which it is, or should be, the object of every teacher to prevent.

Of the numerous works on the calculus produced during the last few years, the book before us is a good average sample. Owing to the class of readers for whom it is intended, it inclines to be "long-winded" and "prosy"; x^n is the only function whose differential coefficient is required in the first 250 pages. Thus there is a mighty *leading up* to the subject, a drawn-out attempt to get the student into a state of mind to grasp it; and the very laboriousness of the process must at once convince anyone that a condition of brain requiring such an absurd amount of preparation is artificial. How much better it is to wait till Nature does most of this work, to wait till the boy is a few years older, till the critical age is passed, till all this absurd forcing becomes unnecessary.

The book evidences a great amount of painstaking effort, and, if the limitations referred to above are understood, is one that a teacher may use with discretion for his older students.

We trust, however, that no further books on the calculus for engineers will be published for some time, as the market is now well supplied with works of this type.

The Design of Static Transformers. By H. M. Hobart, M.Inst.C.E. London: Constable & Co., Ltd. Price 6s. net.

This book treats of the design of transformers, and more particularly single-phase transformers, from an essentially practical standpoint. Purely theoretical work and fundamental principles are almost entirely omitted, and the author refers the reader to the two standard English treatises on the subject, and also to one of his own books.

The book opens with an introductory chapter containing an interesting account of Mr. Hobart's personal experience with transformers—from testing in a primitive manner 2-kw. lighting transformers up to actually designing large machines. There is also given a bibliography of papers on transformers which have appeared since 1888. An important paper on design, which does not appear in this list, is the one by Mr. A. R. Low, published in Vol. XLIII of the Journal of the Institution of Electrical Engineers.

In Chapter II a method is given for determining the leading dimensions of a transformer of given rating, and a particular case is worked out fully for a 20-k.v.a. transformer. This method consists in using a considerable number of curves for obtaining various factors required in the calculation, and is almost exclusively of an empirical character. This, perhaps, is the best method until a man has acquired the necessary experience and confidence by lengthy practice at transformer design, but a certain amount of faith is requisite to take a number of curves for granted, The economical design of a transformer depends to a very large extent on the dimensions adopted for the winding window; and the information given in the curves co-ordinating winding width with output is substantially the same as that in a private notebook used by the reviewer. In this chapter the author predicts future sorrow on the part of electrical manufacturers who are not taking up the construction of transformers with avidity, and there is something to be said for this, as transformer manufacture does not necessitate a forest of patterns, although prices are somewhat "cut."

Chapter III is a short account of the relation between core loss and annual efficiency, and the same 20-k.v.a. trans-

former is taken as an example. It is here pointed out that any considerable reduction in the core loss below a certain minimum means bad regulation, and the cause thereof is very ably entered into.

Magnetising current, power factor, &c., are treated in the next chapter, and the effect of the alloyed steel, almost universally used nowadays, compared with the old-fashioned iron of former times, is well shown by means of curves. The author rightly lays stress on the fact that owing to poor administration it is a common occurrence for the establishment charges to make a very large percentage of the total works cost. In certain large concerns in which the reviewer has had personal experience, the reverse is very much the case. It is not only in small works that a very keen eye indeed is kept on financial matters of all and any kind.

In Chapter V we have four pages devoted to the consideration of windings and their insulation. A curve is given for the thickness of insulation between primaries and secondaries, and the author says "this may safely be used when suitable insulations are intelligently employed," which is somewhat indefinite. More information as to the several materials now used for this work should certainly have been given.

The influence of the frequency is treated in the next chapter, and tabulated designs are given for cycles of 15, 25 and 50 for a 20-K.V.A. transformer; the increase in core loss at the lowest frequency is well shown, notwithstanding the much greater amount of material employed.

The regulation of transformers receives attention in Chapter VII, and Kapp's two diagrams are well described and worked out for the above-mentioned 20-K.V.A. transformer.

Chapter VIII is the longest but one in the book, and deals with the heating of transformers. Some of the constants given for the estimation of the temperature rise coincide almost exactly with those used by the writer. Mr. Hobart very rightly condemns the advice of certain manufacturers who recommend the allowing of temperature rises of the order of 150° C.

Containing-cases and tanks are described in the next chapter and some good practical information is given.

The book concludes with a chapter on large forced cooled transformers, and data are given as to the amount of air and water required by the different types.

This treatise is regarded by the author as merely introductory, and such important subjects as the mechanical stresses in the windings, the design of terminals and bushings, additional insulation of end turns, protective devices, auto-transformers, &c., have not been included. This is rather a pity, since the book is only a small volume of 174 pages.

A blemish in the book is undoubtedly caused by the use of commas for the decimal points, and it is difficult to understand what Mr. Hobart expects to gain by the introduction of this unusual feature. There are also a few illustrations of the manufacturers' catalogue type which take up space and do not appear to serve a very useful purpose, and it would have been better had a few plates of working drawings been substituted.

The book is free from nebulous discursiveness, and a distinctive peculiarity is that vital dimensions can be obtained in a rapid and efficient manner. The book is well printed, bound in a serviceable style, and worth the price asked for it.—H.G.S.

BUSINESS NOTES.

Consular Notes.—Japan.—The following information is from the report by H.M. Consul-General at Kobé (Mr. R. de B. Layard) on the trade of that district in 1910, which will shortly be issued:—

The outstanding feature of the year was the number of gas plants which were set up, both for supplying towns with gas and for small suction gas electric power stations. In the early part of the year the bulk of the orders were given for British machinery, but during the latter half Continental firms secured a number of important contracts, principally by undercutting British prices. During the latter part of the year local manufacturers also secured orders for the less important parts of the town gas plants, only the main machinery being imported. As regards rubber electric cables, a local factory, equipped with British machinery and having the services of a British cable expert, has made great progress since last year, and can successfully compete with British goods in price and delivery. As regards quality, time alone will prove. For paper-insulated cables there is still a demand, and large contracts have recently been secured by Continental manufacturers at very low prices.

Local industrial development is most noticeable in electrical enterprises, such as electric tramways and railways, and in the installation of power stations for electric lighting, &c. Although the aspiration of the Japanese merchant is towards "direct trade" and the entire elimination of the foreign merchant as the medium of trade, there seems to be no likelihood of such consummation. With the exception of Japanese firms with well-established business connections abroad, the majority must find it to their profit to deal with the local foreign merchant, who is fully informed as to requirements in his own country. Foreign firms on the spot who import machinery and other classes of goods, keep themselves fully posted as to Japanese requirements, and are also in the best position to fill contracts which are made privately and are not put up to public tender. At the same time, there seems to be a complaint of the lack of British commercial travellers—not a new complaint by any means in the Far East. Such men should be experts, though not necessarily acquainted with the Japanese language, as English is the general business tongue in Japan, and, in any case, interpreters can be secured if required.—*Board of Trade Journal.*

Book Notices.—*The Electric Clock Buyer's Catechism*, published by the Silent Electric Clock Co., of 192, Goswell Road, E.C., is an ingeniously-devised little pamphlet, in which, by question and answer, the hypothetical buyer is made acquainted with the leading features of electric clock systems—in particular, of course, that of the company above-mentioned—and is eventually so far convinced that he writes to them for their catalogue. The facts that the "Silent Electric Clock" never needs winding, suffers practically no wear and tear, and is admirably adapted for use on board ship, are brought out, and a long list of installations is given.

"Science Abstracts." Vol. XIV, Part 8. August 25th, 1911. Sections A and B. London: E. and F. N. Spon, Ltd. Price 1s. 6d. net each.

"*Proceedings* of the American Society of Civil Engineers." Vol. XXXVII, No. 6. August, 1911. New York: The Society.

Correction.—In the advertisement of the SLOAN ELECTRICAL CO., LTD., in our last issue, their telephone number was incorrectly given. It should be 4,380, not 4,360.

Marking Time.—Among recent sales made by the INTERNATIONAL TIME RECORDING CO., of 151, City Road, E.C., are the following:—Waterlow Bros. & Layton, three recorders; Gramophone Co., nine recorders; London General Omnibus Co., 14 recorders; Gale & Polden, two recorders; Rolls-Royce, Ltd., two recorders; British Thomson-Houston Co., two recorders; Swan, Hunter & Wigham Richardson, Ltd., three recorders; Reuben Gaunt and Sons, six recorders.

Dissolutions and Liquidations.—SOLIUM ELECTRICAL CO., LTD.—Creditors should send particulars of debts, &c., to the liquidator (Mr. E. Harlow, 23, King Street, Nottingham) by September 30th.

MIDLAND ENGINEERING CO., LTD.—A meeting is to be held at 11, Waterloo Street, Birmingham, on October 5th, to hear an account of the winding up from the liquidator, Mr. H. W. Brettell.

Electrical Trade in Austria.—The exports of electrotectnical articles from Austria-Hungary in the month of June thi year, shows a further advance on the record figure previously reported. The increase in exports is especially noticeable in glow lamps, the aggregate from January to June, of which reaches the value of 3,120,000 kr., against 1,750,000 kr. in the same period of the previous year. The improvement consequently amounts to nearly 80 per cent. The export of arc lamps likewise advanced, namely, from 137,340 kr. to 202,440 kr., or about 70 per cent. Cables and insulated wire also showed improved figures, namely, 270,000 kr., against 154,000 kr. in the first half of 1910, and carbons, 605,000 kr., against 484,000 kr. The total value of all electro-technical articles exported was 5,374,000 kr., against 3,842,000 kr. in 1910. On the other hand, the imports of electro-technical articles attained the figure of 13,597,000 kr., against 10,855,000 kr., in which figures dynamos ranked for 5,170,000 kr., against 4,167,000 kr. in 1910. Measuring instruments stood for 2,800,000 kr., against 1,800,000 kr. (an advance of 50 per cent.), and carbons 380,000 kr., against 232,000 kr., or a 70 per cent. increase.—*Elektrotechnik und Maschinenbau.*

Petrol-Electric Omnibuses.—We are informed that as a result of the successful running of the new "Tilling-Stevens" petrol-electric omnibuses in London service, Messrs. Tilling have decided to adopt that type for all their future omnibuses, and are constructing a fleet to replace their present horse-drawn vehicles. Messrs. Tilling have designed the chassis and body, which are being built at their works at Peckham. The electrical transmission is supplied by Messrs. W. A. Stevens, Ltd., of Maidstone. An agreement has been entered into between the two companies, in which Messrs. Tilling have secured the sole rights of use and sale of the "Stevens" patent electrical transmission for use in omnibuses and mail vans in the Metropolitan Police area, Messrs. Stevens to have the sole rights of manufacture and sale of the complete "Tilling-Stevens" petrol-electric chassis outside the Metropolitan Police area, and also inside the Metropolitan area for vehicles other than omnibuses or mail vans. The same con-

struction will be adopted in the chassis for use either inside or outside London. The "Tilling-Stevens" petrol-electric vehicles are the result of exhaustive experiments extending over a period of four years under public service conditions in London. The first vehicle, which is still in service in excellent condition, has run over 120,000 miles. As the new vehicle has been designed by the oldest-established motor-omnibus company in London to meet the latest requirements of the Metropolitan Police, it possesses all the essential qualifications for success, and its extreme silence, smooth running, flexibility and ease of control, together with low cost of upkeep due to the substitution of a flexible electrical transmission for the gear box, should appeal to the travelling public as well as to the operating engineer.

Trade Announcements.—The Walsall Electrical Co., Ltd., have appointed Messrs. Paterson & Service, of 38, Bath Street, Glasgow, as their sole agents for Scotland and Islands.

Messrs. Farraway Bros., of Chelsea, have opened new additional showrooms at 146, Kensington High Street, W., where they would like to receive manufacturers' catalogues, &c., of electrical accessories and accumulators.

Electric Light at the Coronation Durbar.—The general illumination and lighting at Delhi and other towns during the visit of their Majesties King-Emperor and Queen-Empress will form one of the most important and attractive features of the occasion. Several of the most important contracts have been placed with Messrs. F. & C. Osler, Ltd., of Bombay and Calcutta. The principal of these contracts cover the King's Camp in Delhi, as also the Viceroy's, the Circuit House in Delhi, where his Majesty will reside, and a large majority of the Indian Chiefs' camps, including those of Hyderabad, Bhawalpur, Travancore, Mysore, Cooch Behar, Benares, &c., numbering in all 40 camps. In addition, Messrs. Osler have also received orders for a very large number of electric light pillars required for the external lighting of the camps. The same firm has received the contract for the lighting of the Agra Circuit House, where her Majesty the Queen will stay when the King is in Nepal.—*Indian Textile Journal.*

Bankruptcy Proceedings.—J. D. Carlmark, electrical engineer, West Bromwich.—First and final dividend of 11d. in the £, payable September 11th, at 191, Corporation Street, Birmingham.

Foster Arc Lamps.—The Foster Engineering Co., Ltd., of Wimbledon, have secured the order for 450 of their B.E. type single enclosed arc lamps for Messrs. William Whiteley's new premises. The same firm recently supplied a large number of lamps of the same type for Messrs. Pinchin & Johnson's factory, and Messrs. Arding & Hobbs's store at Clapham Junction was lighted in its interior by over 70 of the Foster arc lamps. The B.E. lamp has been made by the firm for a number of years, and its popularity continues to increase. It burns equally on either A.C. or D.C.; the consumption is under ½ unit per hour, and the lamp only requires trimming every 80 hours, this being the life of a pair of carbons.

Catalogues and Lists.—Messrs. Matthews and Yates, Cyclone Works, Swinton, near Manchester.—Twenty-four-page booklet relating to the Cyclone Plenum system as applied for the heating and ventilation of industrial buildings. The system is very fully illustrated, the Cyclone electric fan, electric blower and exhauster, blower and heating battery being shown, also the system applied in humidifying and ventilating weaving sheds, removing steam from a dye-house, &c.

The Maschinenfabrik Oerlikon, Oswaldestre House, Norfolk Street, Strand, W.C.—Leaflet illustrating and describing their portable insulation cutter for commutators.

Mr. Percy Pitman, 3, Willcott Road, Acton, London, W.—Price list of Pitman water wheels, also a six-page pamphlet describing same, together with a list of the improvements with which they are now fitted; price leaflets relating to the "Hector" turbine bottle brusher and the Hector hydraulic motor. The firm has orders in hand, or recently completed, for the following, among others:—Dublin Corporation, Regent Street Polytechnic, Belfast Technical College; National Electric Construction Co., Ltd.; Egyptian Government, and Hartley University College, Southampton.

The British Aluminium Co., Ltd., 109, Queen Victoria Street, London, E.C.—Leaflet illustrating torsion sleeve joints for overhead transmission lines.

The Phœnix Dynamo Manufacturing Co., Ltd., Thornbury Works, Bradford.—Two "Phœnix Bulletins," eight pages each. No. 2A deals with direct-current generators and large motors, and No. 4A with alternators. The contents in each case consist of illustrated specifications of the machines, both the parts and the complete machines being shown by reproductions from photographs. In the alternator bulletin sizes and outputs are tabulated, and a list of recent installations is given.

Messrs. Siemens Bros. Dynamo Works, Ltd., Tyssen Street, Dalston, London, N.E.—New price list, "D 1," giving illustrations of a variety of new designs of glass shades for tantalum and tungsten lamps. Contractors who are considering their stocks just now when consumers are overhauling their lighting accessories in readiness for the darker evenings, will find reflectors listed here for all types of fittings. The assortment of shades includes satin finished, opalescent and etched types, also coloured bead shades. Readers interested can have copies of the list on application.

The India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd., Silvertown.—List No. 40A, of 24 pages, containing tabulated sizes, prices and other particulars of twin cables, concentric and high-tension cables, flexible conductors and cords.

Messrs. Rose Bros., 38 and 39, Beech Street, Barbican, London, E.C.—Supplementary catalogue (1911-12) of pocket electric lamps, watch stands, coils, motors, bichromate batteries, toy electric trains and trams, hand and cycle lamps, and sundries. The catalogue is well illustrated, and shows prices very distinctly. A separate list gives prices of the "Comet" dry batteries.

LIGHTING and POWER NOTES.

Aberdeen.—The T.C. has fixed the rate for electricity at 3½d. per unit for lighting, 2½d. to ⅞ths of a 1d. for power, and 1d. for heating. This is a reduction of ½d. per unit for lighting.

Accrington.—The Electricity Committee has decided to obtain an automatic pressure regulator for the Oak Hill sub-station at a cost of £62, and to expend £50 for stock for the showroom to be opened at the Post Office Arcade. At the request of the Haslingden Corporation, the Committee agreed to allow its staff to supervise the laying of the mains in connection with the electricity supply of Haslingden, subject to a payment of £3 per week for such services.

Barrow.—In his annual report, Mr. H. R. Burnett, the borough electrical engineer, states that the capacity of the generating plant is still sufficient to deal with the demand, and no additions to it have been made during the past year, but the feeder panel and oil separator have been connected up and put into service, and the latter has effected a reduction in the consumption of water. In November, 1910, the Local Government Board sanctioned the borrowing of a further £4,500 for extensions of mains, &c. As this sanction was given without the holding of an inquiry, it is assumed that the Board is satisfied with the position of the undertaking and with the manner in which the information required by the Board with regard to the various loans has been supplied. A table illustrates the growth of the undertaking during the last 10 years, and shows that the number of consumers is now 904; lamps, 88,979; units sold, 1,249,163; maximum load, 951 kw.; load factor, 14·99 per cent. The output for all purposes during the year has increased by 10·5 per cent., which is the largest increase so far obtained since the commencement of the tram service. The largest increase is again in the supply for power and heating purposes, the output for which for the first time exceeds that to the tramways. There is every prospect of a further large increase in output for power purposes in the near future, and since the price of electricity was reduced to 1d. per unit, the demand for supply for domestic heating purposes has shown satisfactory signs of development. The financial result of the year's working is as follows:—Total receipts, £14,435; total costs, £6,406; per cent. of costs to receipts, 44·38; gross profits, £8,028; per cent. of gross profit to capital expended, 6·98; total costs per unit 1·231d.; average price obtained per unit, 2·717d. Financial result: profit, £706. In conclusion, the report reviews the receipts and expenditure, and Mr. Burnett says that the capital redeemed after only 12 years' working exceeds the cost of the original works, in addition to which there is a sum of £998 standing to the credit of the renewals funds.

The T.C. on Monday authorised the electrical engineer to obtain a few grillers and heaters for letting out on hire, at a cost not exceeding £50; also to install an electrically-driven centrifugal pump at the electricity works for raising the water from the hot well to feed the water tanks, at a cost of about £70.

Bath.—The T.C. having applied for a loan of £7,900 for the provision of a Diesel engine plant at the electricity works, a L.G.B. inquiry will be held on September 15th.

Biddulph.—A meeting of the Finance Committee of the U.D.C. is to be held on 12th inst. to receive the report of the canvass of property-owners with reference to the proposed electric lighting scheme.

Bognor.—Mr. Tate, having informed the U.D.C. that he intends applying to the B. of T. for a prov. order for electric lighting, the Council on Friday decided to discuss the matter in committee on September 8th.

Braunton.—The formation of the E.L. and Power Co., which is to undertake the public and private lighting of the parish, is now practically assured, almost all the necessary capital having been subscribed.

Bridlington.—The T.C. has applied to the L.G.B. for a loan of £1,500 for the installation of a new feeder cable from the electricity works to the junction of Horsforth Avenue and Neptune Street.

Brighton.—The Lighting Committee has recommended the T.C. to abolish meter rents, except in the case of consumers upon the maximum demand system, and to make certain reductions in the charges for energy.

Bury St. Edmund's.—The electrical engineer, in his annual report, refers to the satisfactory nature of the past year's results. The all-round expansion of the business, although steady, is most marked. The number of new consumers connected during the year has been well maintained, and an increase of over 20,600 units, representing an income of about £450, have been sold. For the increase in the works cost, the coal bill is mainly responsible. This

is partly due to the fact that, although there was a considerable increase in the output, the amount of refuse, naturally, did not increase proportionately, but at times, owing to the wet season, left much to be desired for steam-raising purposes. Again, the inefficiency of the condensing plant and its inability to satisfactorily deal with the heavy winter loads, as has already been reported, was in no small measure responsible for an increased coal consumption. The importance of these matters has been fully realised, and in order to obtain a greater use of the destructor steam-raising plant, experiments have been made during the past few months with various fuels to assist the burning of the refuse, and for use at such times when sufficient refuse cannot be obtained. In this respect, coke has given good results—especially when burnt alone—but the cost is somewhat high, and during the past month trials have been made with "slack," and the results have been eminently satisfactory. The removal of the condensing plant from the boiler house, and the thorough overhauling of this plant generally—which work is now in hand—will practically overcome the difficulty in this respect, and a marked economy in fuel consumption should result, and, with the economy that will be obtained by the new generating plant now about to be installed, there should be a substantial reduction in generating cost during the present year.

Caergwrle (Wrexham).—A correspondent writing in regard to a small local electricity company, says:—"This small company was formed on my representation to some local people that since the advent of the tungsten lamp, and given permission to use bare overhead mains, electric light was commercially possible even in a village like this (about 1,500 population). Of course, the price per unit is higher, 8d. at present, but this allows a 17-watt lamp to be run 7½ hours for 1d., and this, by the testimony of our customers (many of whom have 1d. slot meters) is *cheaper* than oil, and, of course, vastly superior. There is no gas company here. The supply was turned on on July 16th, 1909, over two years ago, and has never failed since for one second, night or day. It has grown slowly and steadily, but now there is a mighty rush for it, and in a month or so we shall have double the number of lamps we had three or four months ago. The Gwalia Forge supplies steam power at so much per unit, and the attendance is provided at a contract rate per unit—total cost at present 4¾d., leaving 3¾d. per unit for the company for sinking fund and profit."

Cavan.—At a special meeting of the Urban Council last week the following notice of motion was handed in by Mr. Pollock: "That the Urban Council proceed forthwith to install an electric plant for the purpose of the public and private lighting of the town, and that a sufficient sum be borrowed to carry out the scheme."

Ceylon.—The Colombo Electric Tramways and Lighting Co. have recently installed a 300-KW. tandem set, consisting of a Belliss & Morcom engine, Dick, Kerr D.C. generator, and G.E.C. (U.S.A.) alternator. Early in 1910 a 225-B.H.P. Diesel engine built by Messrs. Willans & Robinson was installed, to displace a Macintosh Seymour steam engine of similar size, and the installation of a 525-B.H.P. Diesel, built by Messrs. Carels Frères, of Ghent, is now in progress, coupled to a 350-KW. Lancashire Dynamo and Motor Co.'s generator.

Cheltenham.—The mains are to be extended to the Ryeworth Estate, which is now being developed for building purposes. The Council's application to the B. of T. for a prov. order extending the Cheltenham lighting area, to include the parishes of Leckhampton, Swindon and Prestbury, and the parishes or hamlets of Bishop's Cleeve, Southam, Brockhampton and Woodmancote, is to be proceeded with. The borough electrical engineer is to prepare a scheme and plan showing the area, &c., to be included in the order, and the Cheltenham and Winchcombe R.D.C.'s are to be asked for their consent to the application.

Chile.—The *Diario* of June 26th contains a decree approving a project submitted by Don Salvador Correa for supplying the town of San Vincente, department of Caupolican, with electric light. Work is to be begun within six months, and finished within a year, from the date of the decree (June 20th).—*Board of Trade Journal.*

Continental Notes.—ITALY.—The Provincial Council of Piedmont, at its last sitting, has approved of the erection of a water power station in the Orco Valley of a total capacity of 40,000 H.P., the estimated cost of which is put at 33,010,000 lire. This outlay will include the regulation of the natural streams of the whole valley and the afforestation of the mountain slopes, so that improvement works on a large scale are contemplated. The province will not, however, itself carry out these works, but will hand them over to a company, who will be pledged to set apart a portion, free of cost, of the electric power for the use of the province, so that the latter will derive not only the economic advantages which such important works will confer, but a constant income from the sale of electric current.—*Elektrotechnik und Maschinenbau.*

Statistics recently compiled show that Italy possesses some 29 large electric supply concerns of capacities ranging from 77,400 H.P. to 3,250 H.P. The largest number of these concerns—10—are situated in the Province of Milan, the distribution of the remainder being as follow:—Three in Torino, two each in Venezia, Genova and Napoli, and one each in Brescia, Roma, Bari, Firenze, Como, Palermo, Lecco, Porto Maurizio and Intra. Only a few of these concerns are run wholly for single industries, the majority selling their current to various consumers. Their operations thus tend to the creation of industries where none existed before, or to the enlargement of previously existing undertakings. The mechanical, chemical, textile, lighting, transport, milling, &c., industries have thus been greatly stimulated in their development, the new power tending to the substitution of forms of large output capacity for small industries sparsely scattered here and there.—*L'Ingegneria Ferroviaria.*

AUSTRIA.—The extensive scheme of the Pretovia Co. to erect a large hydroelectric establishment on the River Drau has successfully passed the scrutiny of the Imperial Commission, the only objection urged against it being easily met by the raising of the dam wall, whereby the normal capacity will be increased to 54,000 H.P. Furthermore, the stretch of water between the two stations can be converted into a reservoir to equalise the supply in the various seasons.—*Elektrotechnik und Maschinenbau.*

At a meeting recently held at Preore (Tyrol), at which 25 representatives of communes were present, it was decided to erect a central station at Zuclo, making use of the waterfall of Ri di Mulini for the generation of power. The plans for the scheme have already been drafted by the Unione Trentina.—*Zeitschr. Oest. Ingenieur und Architekten Vereins.*

BOHEMIA.—A new central electric lighting and power station is about to be established in the town of Jungbunzlau.

SPAIN.—La Sociedad Hidro-Electrica de la Cerbigona is the name of a new company which has lately been formed at Hojos (Caceres) with a capital of £10,000 to establish a small central station for the electric lighting of the town and several places in the district.

Devonport.—The main generating station for electrical power and lighting in the North Yard, Devonport, and the new generating station for pneumatic power in the South Yard, are receiving considerable additions to their equipment. At the first-named station the new turbo-dynamos have a B.H.P. of 1,600. In the new South Yard station, which is devoted to the storage and distribution of compressed air, the air compressing plant is driven by motors of from 400 to 500 H.P., this being one of the largest air compressing installations to be fitted.

Eastbourne.—Mains are to be extended to Cavendish Place at a cost of £125. The E.L. Committee has decided to make a rebate of ½d. per unit to all consumers whose supply exceeds 40,000 units per annum.

Garvagh.—A meeting of the shopkeepers and residents of Garvagh was held on 29th ult., for the purpose of making arrangements in connection with the proposed adoption of an electric lighting system. It was agreed that 14 lamps of 25 C.P. each be erected and placed at regular intervals between Hermitage Porter Lodge and the Upper Bridges, the expense for their upkeep to be levied on the rate of the townland of Garvagh. A sub-committee was appointed to confer with Mr. Stewart as to the necessity for the installation of accumulators. Reports as to the number of house-owners who were agreeable to adopt the light were considered satisfactory, only some three or four having refused.

Greetland.—The U.D.C. has decided to apply to the B. of T. for a prov. order for E.L., with a clause authorising the transfer of the order to the Electrical Distribution of Yorkshire, Ltd.

Herne Bay.—The U.D.C. on August 30th discussed *in camera* the question of transferring the E.L. order to the Gas Co. or Messrs. A. E. Hunt & Sons, a local firm. No decision was arrived at, and the subject was again referred to the Law and Parliamentary Committee.

Hoyland.—A Committee has recommended that Mr. Senior, of Mexbro', be engaged by the U.D.C., at a fee of 10 guineas, to report in the matter of the application for a prov. order by Electrical Distribution of Yorkshire, Ltd.

Hyde.—At a meeting of the T.C. some information was given relative to the merits of gas and electricity for street lighting purposes. In moving the adoption of the minutes of the Committee, Councillor Robinson stated that the cost of the electric lighting installation was 50 per cent. more than gas, and the maintenance, taking the price of energy at ·825d. per unit (as quoted by the Joint Board) was 33 per cent. more. Since these figures were worked out, however, they had been informed that the lamps would be charged for at the rate of 13s. 9d. each for energy. This reduced the price of energy to ·75d. per unit, the maintenance being reduced from 33 per cent. to 25 per cent. dearer than gas. After going into the figures very carefully and examining the lights in the streets, the Committee had come to the conclusion that they could see no reason for changing to electric light, and they had, therefore, decided to carry out the street lighting improvement with gas. The Committee's recommendation was confirmed.

Inverness.—A rather serious fire occurred at the generating station of the North of Scotland Electric and Power Co., on Sunday afternoon. The engineer and manager, Mr E. J. Williams, who lives quite near, was on the scene immediately, but the fire had got a good hold. Mr. Williams and others tried to keep the fire in check with the works' appliances, but by the time the brigade arrived, the entrance hall, lobby, workshop, store above, and meter room were involved, the wood stairs to the latter being quickly demolished. The brigade directed their efforts to prevent the fire spreading to the battery rooms and wiring store, luckily with complete success, although the door leading to the former was destroyed. Considerable damage was done to interiors and to stock, and all the copper rod connections between the battery and switchboard were destroyed, as well as the entire stock of meters and indicators. It being Sunday the plant was not running, and the interruption to the supply caused little inconvenience. By 4 o'clock temporary connections had been made, and the supply was resumed. The fire, which originated near some lockers where the staff keep their overalls, was probably caused by a match thrown down amongst some waterproof coats used by the mains' staff. At no time was the generating plant in jeopardy, as there is a 3-ft. gable between the engine room and the rest of the building.

London.—Shoreditch.—The Lighting Committee has recommended the conversion of the whole of the gas lamps in the streets north of Old Street to incandescent electric lighting at a cost of £665. The necessary cables, 14 miles in 160 streets, are to be laid at an estimated cost of £8,385. These cables are to be of sufficient size, not only for the street lamps, but to meet any reasonable demand likely to arise. The work will be done gradually.

The Lighting Committee has submitted a revised scale of charges for power and for factory lighting, which, it is proposed, shall take effect after the September meter readings, the reduction of income being estimated at £2,512 per annum.

Merthyr Tydfil.—The Electric Traction and Lighting Co., Ltd., has offered to install the E.L. at Mardy Hospital for £220, and to supply current on a five years' agreement by overhead mains at 3d. per unit up to 5,000 units per annum, and 2d. per unit beyond. The estimated quantity required per annum is 5,000 units, the cost of which would be £62 10s., whereas gas would cost £110. The Visiting Committee recommended the acceptance of this offer, but the T.C. has deferred its decision, with the view of obtaining other tenders.

Norton (near Malton).—The U.D.C. has decided to substitute gas for electricity as the motive power in the pumping of water at the waterworks. Some years ago the Council changed from gas to electricity. Recently a five years' tender for pumping was invited from the Malton Gas Co., and from the Northern Counties Electricity Supply Co. The tender of the electricity company, which was based upon the units used in the last contract, amounted to £171 per annum, that from the gas company being £96. The Council decided to accept the latter.

Peterborough.—Complaints having been made of the unsatisfactory state of the electric light at the public library, it has been found to be due to the variations in the voltage caused by two adjacent cinematograph halls. The proprietors of the halls have been called upon to provide appliances to prevent disturbance in the general public supply, and unless this is done the supply of current for cinematograph purposes will be discontinued.

The T.C. has decided to delete a minute from the Electricity Committee recommending a free supply of electricity to the private residence of the chief assistant engineer.

Plymouth.—The annual report of the borough electrical engineer (Mr. E. G. Okell) for the year ending March 31st last, states that connections for supplies to 140 new consumers have been made, and the total lamp connections have been increased from the equivalent of 89,107 to 96,276 30-watt lamps. The number of motors on private consumers' premises is increased from 162 to 188, representing an increase of 90 H.P. connected, the aggregate total horse-power at the end of the year being 663. The total number of units sold has increased from 2,456,070 to 2,601,277, there being an increase of 17,000 sold to tramways, 121,971 to private consumers and 6,236 used for public lighting; 5,300 yards of cable have been used for extensions and for the connection of new supplies. During the year 87 vessels have been discharged by means of the transporter. The statement of income and expenditure for the undertaking shows that the total cost of production is slightly below the figure realised in the year 1908-9, and is therefore the lowest yet recorded. The works cost for the last three years have been ·91d., ·88d. and ·83d. respectively, and the total cost 1·23d., 1·30d. and 1·22d. per unit, exclusive of capital charges. The quantity of coal used is larger than last year, and the price paid has also averaged slightly higher. The total expenditure incurred in the production and supply of electricity for generation, distribution, management, &c., has been £13,202, as compared with £13,308 for the year 1909-10, a reduction of £108, notwithstanding the increased output and load. After setting aside £9,848 for interest and sinking fund charges there remains a balance of £2,967, from which £1,797 has been taken to meet the cost of new meters, services and mains, leaving £1,170 to be taken in aid of rates.

Runcorn and Widnes.—Rapid progress is being made with the laying of electricity mains in Runcorn and Widnes by the Mersey Power Co., and it is anticipated that supply will be available by October.

South Africa.—Kimberley.—Practically all the electricity used in Kimberley is supplied by the power station of the De Beers Consolidated Mines, Ltd. The plant comprises 12 Babcock and Wilcox boilers, with superheaters and mechanical stokers, induced draught and economisers, and three Westinghouse-Parsons turbo-generators of 1,500 KW. each, with surface condensers. An additional turbo-generator of the British-Westinghouse Rateau type, giving 4,000 KW. at 5,000 volts, three-phase, 50 cycles, is now being erected, making the total capacity of the plant 8,500 KW. The supply pressure is 220 volts A.C., for lamps and motors; the Town Council is supplied with electricity in bulk for lighting the town, which is done with arc lamps about 60 in series on constant-current transformers from the 5,000-volt mains. Energy for traction is supplied through rotary converters to the Alexandersfontein Railway (7 miles), and the Victoria Tramway Co.'s system (4 miles). The machine tools in the De Beers workshops are driven by D.C. motors at 220 volts, supplied from synchronous motor-generator sets; with this exception, and that of the traction supply, all power is A.C., motors over 100 H.P. each being generally supplied at 5,000 volts. Underground lamps are supplied at 110 volts, and motors at 220 volts A.C.

Rand.—*African Engineering* states that the Rand Water Board are installing two electricity driven high-lift centrifugal pumps, each capable of raising 2,500,000 gallons a day, at Zurbekom.

The same exchange reports that Mr. Kotze, the Government mining engineer, estimates that if the electric generating and coal companies of the Rand were to combine they could produce electric energy at ¼d. per unit.

It further states that "the Randfontein Estates Co. are supplying electric energy at a cost of ¼d. per unit. The cost of the Randfontein generating plant works out at £16 per KW. installed. The working costs amount to 0·247d. per unit, of which 0·153d. is accounted for by fuel.

South Shields.—During the past year, the Corporation electricity supply department sold 3,476,539 units, as compared with 3,166,296 units for the previous year, an increase of 9·7 per cent. The lighting units sold last year increased 1·5 per cent., the power units increased 74 per cent., but the traction units decreased 14·4 per cent. The average price charged per unit (private and public supply, less public lamp maintenance) was 1·76d. as against 1·84d., a decrease of 4·3 per cent., whilst the working expenses per unit (less public lighting maintenance) were ·86d. as against ·95d., a decrease of 9·4 per cent. The maximum combined load on the station was 2,054 KW., as compared with 1,760 KW. in the previous year, and the combined load factor was 19·32 per cent., as against 20·53 per cent. in the previous year. The total capital expenditure at the end of the last 12 months was £188,173, the total revenue £26,307, and the gross profit £13,122, the last-mentioned figure showing an increase of 12·7 per cent. over the previous year's figures, and giving a percentage of gross profit to total capital expenditure of 6·9. The price obtained per unit for private supply, lighting and power, was 2·08d., a decrease of 14 per cent.; for public supply, lighting (less public lamp maintenance), 1·29d., or an increase of 2·3 per cent., and the price for public supply and traction was 1·41 d., or an increase of ·7 per cent. over the previous year's price. Owing to the increased demand for power, the Corporation recently obtained the sanction of the L.G.B. for the borrowing of £7,580 for the provision of new plant at the electricity works. The total estimated cost of the scheme is £10,080. The balance of £2,500 will be taken out of the electricity undertaking reserve fund.

A contract has been placed with the British Westinghouse Co. for a 1,500-KW. 1,500 R.P.M. high-pressure Rateau turbine, direct coupled to one 1,000-KW. D.C. generator for traction and power work, and also direct-coupled in tandem one 1,100-KW. single-phase 50 periods 2,100-volt alternator for lighting. The plant is to be supplied with a surface condenser, and the circulating water will be obtained from the River Tyne. The air pump is to be of the Westinghouse-Le Blanc pattern, motor driven, and on the same shaft will also be connected the hot water extraction pumps. The amount of the Westinghouse Co.'s tender was £7,972, and the set is to be in running order before the end of the year.

Southport.—The Corporation has applied to the B. of T. for consent to the placing of certain transmission lines above-ground along various routes in the borough for the purposes of supply under the Southport Electric Lighting Order of 1891.

Stoke-on-Trent.—The B.G. has decided to have the electric light installed also electric fans, at the new operating room and medical officer's residence, at an estimated cost of £130, the tenders to be confined to local contractors. An X-ray apparatus is also to be provided.

York.—The Corporation electricity works were opened in April, 1900, and have now a total capacity of 1,860 KW. and a maximum load of about 1,270 KW. The units generated during the past 12 months amounted to 257,269 for public lighting, 739,992 for private lighting, 595,937 for power purposes, and an additional 607,319 for tramway purposes. In view of the gradually increasing demand for electrical power, the Corporation recently sought and obtained sanction for a loan of £14,863 required for extensions to its electricity undertakings. It has been estimated by the city electrical engineer (Mr. J. W. Hame) that, whilst during the current year 2¼ million units will be sold, next year approximately 4 million units will have to be generated. Accordingly, contracts have recently been let for a 1,250-KW. B.T.-H. three-phase turbo-alternator, rotary converters and switchgear to cost £8,006, and for a Babcock water-tube boiler, automatic stoker and steam pipe work at £1,918. These extensions are expected to be in operation about the middle of October.

The T.C. has consented to the Co-operative Society laying an electric cable along the frontage of its premises in Railway Street on payment of an acknowledgment of 5s. per annum.

TRAMWAY and RAILWAY NOTES.

Accrington.—The Electricity Committee has presented recommendations to the Council this week concerning an accident sustained by a tram conductor whilst working on the Haslingden section. The accident occurred while the man was leaving the car to adjust a signal, he being knocked down by a passing motor-car. It was pointed out that if the automatic signalling arrangements operating on the Oswaldtwistle section had been installed, such an accident could not have taken place. The Committee decided that representation be made to Haslingden Corporation with a view to inducing them to adopt the automatic system of signalling.

Aberdeen. — The T.C. has approved of the Tramway Committee's report refusing to recommend that any alteration should be made in the existing rates of pay in the tramways department.

Birkenhead.—It is intended by the Corporation to suitably reward those of its employés who loyally fulfilled their duties during the recent industrial troubles in that town. The Electricity Committee proposes to make the following grants: Mr. W. Wyld (borough electrical engineer), £25; Mr. G. P. Shallcross (assistant electrical engineer), £10; other employés, one week's wages. The Tramways Committee similarly recommends a week's extra wages to drivers, conductors, inspectors, &c., car cleaners, point boys, track cleaners, car repairing, &c., staff, overhead line men, office staff and time keepers, and to the tramway manager's three principal assistants a week's extra wages, or a week's extra holidays, at their option.

Blackburn.—The Tramways Committee has decided to pay each driver and conductor in its service 10s. extra pay for the extra work occasioned by the recent railway strike.

Blackpool.—At the T.C. on Tuesday, Ald. Brodie' chairman of the Tramways Committee, referred to a letter received from the district secretary of the National Union of Gasworkers and General Labourers, asking for certain alterations in the arrangements of shifts and conditions of labour of tramway employés. He thought they would all come to the same conclusion as the Committee did—that the suggested alterations were too ridiculous for consideration. He expressed his appreciation of the loyalty of the majority of the tramway men, whose good sense prevented the men from entering upon a strike which a few discontented ones would have desired. The tramways were having an exceptionally good time, and up to Monday evening the receipts were fully £5,000 more than last year. The estimated loss of receipts caused by the railway strike was from £1,000 to £1,500.

Continental Notes.—GERMANY.—A scheme has been drawn up by the contracting firm of Lentz & Co. for the construction of an electric railway from the centre of the city of Breslau to the much-frequented mountain resorts in the Zobten Mountains. The line, which is to be 42 km. long, will take a different course from the existing State line, namely, up the Sattelhöhe between Zobten and Geiersberg, ending at a point 380 m. above North Sea level. It is contemplated to make the journey in 50 minutes in either direction, and at fares lower than those of the State railway. The rolling-stock will consist of 13 motor-cars, 60 coaches, two post and parcel wagons and 30 goods wagons. Electric lighting and heating plant will be fitted to the rolling stock. The cost of the scheme is put at M. 6,100,000.—*Elek. und Masch.*

According to a German contemporary, the Maschinenfabrik Oerlikon has just turned out an electric locomotive of unusual size and character. It is an alternating-current locomotive of 2,000 H.P. capacity, 13,000-kg. tractive force, and working at a pressure of 15,000 volts and 13 to 17 periodicity. It is thus larger than that built last year by the A.E.G. for the same line; than that built for the Simplon tunnel by Brown, Boveri & Co.; than that built two years ago for the Pennsylvania Railway, and also than the goods locomotive built for the Italian State Railways. It is to be run on the Spiez-Lötschberg-Simplon line. It is from the designs of the engineer, Thormann, and is described by our contemporary as the first demonstration that with single-phase alternating current the highest requirements of existing and projected lines can be satisfied, without exceeding the Continental standards with regard to axle pressure, and without standing behind steam driving so far as regards regular working capacity.

A scheme for the construction of a light electric railway between Grendelbruch and Strasburg is at present under consideration.

AUSTRIA.—Plans are being prepared in respect of a proposed electric tramway between Elbogen and Carlsbad, Bohemia; the Austrian Siemens-Schuckert Co. is interested in the scheme.

Darwen.—The Board of Trade has communicated with the Corporation Tramways Department, suggesting that speed indicators should be fixed on the tramcars. The Committee, however, has decided to defer any such step until the interview between the Board and the Association of Tramway Managers has been held.

Darlington.—The T.C. has applied to the B. of T. for an extension of time for three years for the construction of the tramways to Haughton.

Glasgow. — Following upon the strike of the drivers and conductors in the employment of the T.C. tramways department, some interesting points have arisen. One of these was contained in questions directed to the convener of the Tramways Committee at the last meeting of the Corporation. It was stated in reply that only employés who had been convicted of misconduct had been refused reinstatement, but it was argued by questioners that men who had taken no active part in the dispute, but who had refused to act as temporary drivers, had been dismissed. It was also alleged that men known to be members of the Committee of the Municipal Employés' Association had been refused a restart, and on all points official investigation and report was promised. In a report to the T.C., the Chief Constable points out that in order to provide a suitable force during the strike all leaves of absence had to be stopped, and his men were kept on duty for periods varying from 18 to 24 hours continuously, and provided with food while on duty. The Corporation has approved of a proposal that all constables deprived of their fortnightly day off should be granted a day's pay at the rate of 8d. per hour for the extra time on duty. A special sub-committee has been asked to inquire into a report by the Chief Constable, showing that the services of the police during the strike involved an extra cost of about £1,557, to meet which it is expected the tramways department will be asked to contribute.

The T.C., at the next meeting, is to be asked by the Tramways Committee to petition Parliament for a provisional order to empower it to extend several of the tramway routes both within and without the city. The original propositions included the construction of a relief line from Eglinton Toll to Sauchiehall Street, about a mile and a half in length, and necessitating a new bridge over the Clyde and the removal of St. Enoch's Parish Church and other properties; an extension of about half a mile from the present University terminus to Byres Road; an extension from Kellermont and Canniesburn Toll through Bearsden to Milngavie, a distance of two and three-quarter miles; an extension of about two miles from Cathcart to the Sheddens, between Clarkston and Busby; and a continuation from the present terminus at Baillieston to Coatbridge, about two and a half miles. The total proposed extensions make over 10½ miles of double track. At a meeting of the Sub-Committee on Tramways Extensions the proposals were approved *in toto*, but the parent Committee refused to sanction every item, disapproving of the proposed extensions to Milngavie from Canniesburn Toll and Coatbridge. The Finance Committee, however, have recommended that additional borrowing powers be obtained for the sum of £465,400, subject to the deduction of the amount application to proposed lines not actually approved by the T.C.

The T.C.'s Tramways Committee has also had under consideration the advisability of applying for Parliamentary powers for an amendment of the Corporation Acts, to the effect that the following assessments, which are levied on the full value of the tramway lines, should only be levied on one-fourth of the value thereof, viz.:—Police, sanitary, statute labour, sewage, roads and bridges, parks, registration of births, registration of voters, diseases of animals, and lunacy assessments. It was explained that the other Corporation assessments were only levied on one-fourth of the value, and that this was also the law with regard to assessments on the tramway lines in burghs adjoining the city in terms of the Burgh Police (Scotland) Act, 1892. An amendment that in view of the recent decision of the Sheriff of Lanarkshire and the town clerk, no further proceedings should be taken, was carried.

It is reported in the Press that a Corporation tramcar driver was seized with faintness on Saturday afternoon, and fell from his car. A young man sprang on the car, but could not apply the brakes in time to prevent collision with a car in front. The driverless car was itself knocked off the track, and five passengers received various injuries.

Halifax.—The annual report of the tramways manager, Mr. W. M. Rogerson, for the year ended March 31st last shows that the total revenue was £92,573; working expenses, £60,480; paid in interest on capital, £10,634; paid to sinking fund, £9,823; net profit, £11,514. The capital of the tramway undertaking now stands at £400,149; mortgage debt, after deducting loans repaid, £317,383. Passengers carried during the year, 17,067,865, against 16,323,755 last year. The receipts from parcels increased from £1,803 to £1,922. The staff of the tramways numbers 346.

Huddersfield.—The extension of the borough tramway system from Holly Bank, Edgerton, to the boundary at Birchencliffe was opened on Tuesday, August 29th, a 15-minute service being inaugurated. Negotiations are also proceeding between the Huddersfield Corporation and the Elland D.C. respecting a further extension of the tramways to Elland.

Liverpool. — The Tramways Committee on Friday, September 1st, held its first meeting since the recent labour dispute. The Press were asked to retire, and subsequently an animated discussion took place regarding the total number of men who originally came out on strike, and the total since reinstated. Mr. Mallins (general manager) stated that 435 men were originally out on strike. Of these, 325 were uniformed men, and 210 of them had been taken back. Of the remaining 110 shedmen, 35 had been reinstated. Alderman Salvidge said those figures did not tally with certain statements which were being circulated, and he suggested that Mr. Mallins should make a note of the figures which he (the Alderman) had supplied, and institute inquiries into the matter. Mr. Gates inquired whether any harsh conditions were being imposed on the reinstated men. The Chairman assured the Committee that such was not the case. The men had simply to fill up one of the ordinary application forms, and no question of their trade unionism was involved.

London.—On Saturday afternoon last a four-wheel single-truck double-deck car, owned by the L.C.C., ran off the track at a sharp curve at the end of a slight descent in Lewisham High Road, and then overturned, killing one passenger, a young man aged 20, and injuring 17 others.

The inquest was opened on Tuesday. Evidence was given by the car-driver, by a learner who was with him at the time of the accident, and by L.C.C. officials and others, including a member of the public who was passing when the car went over. The last witness said that the groove of the rail was clogged with sand, and the rail was worn out. The jury in returning their verdict found that the evidence was insufficient to show why the car left the rails, and they added a rider urging that greater attention be paid to the cleansing of rails at junctions and curves.

The Board of Trade inquiry by Col. Von Donop was held on Wednesday.

According to the *Daily Telegraph*, Messrs. John Mowlem & Co., Ltd., have secured the contract for the construction of the Edgware

Road to Paddington Tube, and also the extension from Charing Cross to the Embankment for the London United Electric Railways.

Manchester.—The Manchester and Salford tramway men have decided not to strike, and on Tuesday, at a meeting of the Municipal Employés' Association, Councillor Jones, organising secretary, advised the members to present their demands to the City Council; the meeting passed a resolution to the effect that they should demand redress of their grievances without resorting to a strike. The members of the Association some time ago passed a resolution declaring that after August 31st they would refuse to work alongside non-union men.

Newcastle-on-Tyne.—At a meeting of the Tramways Committee, on August 31st, instructions were given to the city engineer to prepare the necessary plans for carrying out the extensions of the system sanctioned by the Act just passed through Parliament. The new route to Newburn and extensions to the present routes in Shieldfield, Jesmond and Heaton are included.

North Wales.—The B. of T. has authorised the construction of a light railway in the parishes of Maenan, the Abbey, Caerhun, Dolgarog and Trefriw in North Wales.

Rochdale.—On Wednesday, August 30th, the Tramways Committee decided to increase the wages of those employés who had been in its service four years a farthing per hour. This will benefit about 65 per cent. of the workmen, and will mean an increased annual expenditure of £500.

TELEGRAPH and TELEPHONE NOTES.

Chile.—A project for establishing a telephone service in the town of Constitucion has been approved.—*Board of Trade Journal.*

Italy.—In the budget of the Italian Minister of Posts and Telegraphs for 1910-11, there is an extraordinary credit of 3,210,000 lire for extensions of the existing telephone network. These include not only 700 miles of new lines in Italy itself, but also various lines of international importance, viz., the lines from Rome to Milan, and through the Simplon Tunnel; Turin to Milan, and Genoa to Milan, communicating with the German and Austrian systems; and Milan to Chiasso, and Milan to the Simplon Tunnel, to facilitate traffic with Basle and Zurich in Switzerland.—*Elektrotechnik und Maschinenbau.*

Postal Telegraphs.—At a meeting of the National Joint Committee of Postal and Telegraph Societies on Saturday last, the wages and working conditions of telegraphists and linemen were discussed, and it was resolved to ask the P.M.G. to appoint a Select Committee of the House of Commons, and to hold mass meetings in support of this demand.

The Melograph.—The well-known telephone firm of L. M. Ericsson, of Stockholm, is interested in a Swedish invention called the Melograph, a patented registering and reproducing musical instrument, the use of which was recently demonstrated at the works of the firm. The inventor of this apparatus is a Swedish engineer named Nyström, from Karlstad, who in 1891 took out the first patent for the new device, which was at that time very incomplete. The "Melograph," which is worked by means of electricity, can be used in combination with all key instruments, such as pianos and organs. Whilst a piece of music is being played on an instrument in the usual manner, the Melograph registers the tune on a chemically-prepared ribbon, ruled for music, which is covered with a substance resembling wax. The music can afterwards be read like a Morse telegram, and transcribed into ordinary notes. The "Melograph" fulfils a double function; for it not only records, but also reproduces music, with the same expression and rendering as the performer used.

Telegraphing Round the World.—The *New York Times* recently dispatched a telegram of nine words round the world to itself, a route of 28,613 miles; the circuit was completed in 16½ minutes, and the message passed through 16 relays. The record is held by a message sent round the globe on the opening of the Pacific Cable 11 years ago in 9½ minutes, but on that occasion the route was cleared in advance and all the operators were standing by in readiness for the dispatch. The *Times* message, on the other hand, was handled as a purely commercial message. The route was everywhere north of the Equator, passing through Honolulu, Manila, Hong Kong, Singapore, Bombay, Suez, Gibraltar and Fayal.

Wireless Telegraphy.—The Company (Telefunken) for Wireless Telegraphy, of Berlin, announces in its official organ that it has participated to a "considerable amount" in the Australasian Wireless Co., Ltd., of Sydney, which was formed last April with an ordinary share capital of £50,000 and £15,000 in 6 per cent. cumulative preference shares. The Australasian Company has already received orders for two large wireless stations for Australia, and has booked contracts for the equipment of installations on more than 40 merchant steamers. It is added that the Telefunken Co. has acquired the patent rights of the Norwegian, Capt. Hovland, for a secret wireless telegraphic system and the rights of the Russian inventor, Fagan, for a telescopic mast for portable stations.

Wireless Telegraphy in Germany.—Some interesting particulars were given on the progress of wireless telegraphy in Germany at a recent meeting of the Kolonial Technische Kommission. Prof. Goldschmidt stated that reports recently made that wireless communication had been set up between Germany and the Cameroons, 6,000 kilometres distant, were without foundation, or at least were only justified by single successes, without practical value. The bridging of immense distances was proportionate with the size of the appliances used, and, in his opinion, the solution of transmitting wireless telegraphic messages to the greatest distances lay, first, in the construction of extraordinarily large stations and gigantic towers; and secondly, in the employment of great power in order that the waves emitted should give a regular volume of sound in the receivers of intensity superior to that produced by atmospheric and other disturbances. A society had been formed in Berlin, the Hochfrequenz-Maschinen A.G., which possessed a capital of over a million marks, to carry out researches to this end. Prof. Slaby said that the progress made since Marconi transmitted messages 100 miles, to the present, when 5,000 km. were bridged, was largely due to German research, especially in the adaptation of wireless telegraphy to the marine service. But much still remained to be done; it was, however, a well-known fact that Imperial assistance had been given to extensive researches, which had now been carried on for two years, with a view to forwarding messages from the Nauern station to the Cameroons. These researches had not yet achieved the wished-for results, and in technical circles it was not quite clear what the cause was. The solution was thought to lie in the direction of employing machinery of much greater power.—*Elektrische und Maschinelle Betriebe.*

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Victoria.—October 3rd. 42 miles of paper-insulated, lead-covered telephone cable, for the P.M.G. See "Official Notices" August 18th.

Western Australia.—October 18th. 20 coin-in-the-slot attachments for the P.M.G. See "Official Notices" August 25th.

November 21st.—One automatic or semi-automatic switchboard and equipment, for the P.M.G.'s Department. See "Official Notices" to-day.

South Australia.—October 25th. Cable and paper sleeves for the P.M.G. See "Official Notices" September 1st.

Tasmania.—October 2nd. Porcelain insulators for the P.M.G. See "Official Notices" September 1st.

Belgium.—November 27th. The municipal authorities of Tournai are inviting tenders for the concession for the supply of electrical energy for lighting and power purposes in the town during a period of 30 years. The specification can be obtained at the price of one franc from the Hotel de Ville, Tournai.

October 3rd.—La Société Nationale des Chemins de Fer Vicinaux, of Brussels (14, Rue de la Science), is inviting tenders for the contract for the overhead equipment of the Salzinnes-Malonne section of the Onoz-Profondeville light electric railway.

October 4th. Tenders are invited by the same society for the installation of electric traction on the Brussels to Halcht suburban line. The works comprise overhead equipment, transformer sub-station, electric locomotives, &c.

Birkenhead.—The Tramways Committee is to invite designs and tenders for six new cars for the New Ferry route.

Blackpool.—September 19th. Waterproof clothing for tramway employés, for the T.C. Chas. Furness, general manager, West Caroline Street.

Bray (Ireland).—September 19th. 2,500 yd. of concentric, paper-insulated and lead-covered cable, 2,000 volts, for the U.D.C. See "Official Notices" to-day.

Brazil.—November 14th. Tenders are invited by the municipal authorities of Pelotas for a 40 years' concession for the supply of electric power and light, and the establishment and working of electric tramways in the town. For further particulars see this column last week.

Brighton.—September 12th. Electrical fittings for the B. of G. B. Burfield, clerk, Parochial Offices.

Bulgaria.—September 30th. Finance Administration authorities at Sofia. The establishment of a central electric lighting station at the port of Varna.

Eccles.—September 12th. High-tension single-phase alternating-current switchboard, consisting of three generator and five feeder panels, for the T.C. H. W. Angus, electrical engineer, Cawdor Street, Patricroft; returnable deposit of £1 1s.

Haslingden.—September 9th. Electric light installations for various public buildings, for the Corporation. See "Official Notices" September 1st.

Italy.—October 3rd. Italian State Railway authorities in Rome. Three electrically-operated cranes for the docks at Venice.

Keighley.—September 25th. Coal-handling plant, storage reservoir for 200,000 gallons of water, and two circulating pumps, for the Corporation Electricity Works. See "Official Notices" to-day.

Maidenhead.—September 11th. Coal for the electric power station, for the T.C., for a year. Borough Electrical Engineer

Merthyr Tydfil.—September 12th. Electric wiring and fitting for the Mardy Hospital Buildings. Borough Engineer.

New Zealand.—November 1st. Tenders are invited by the Municipal Corporation at Dunedin for (1) a vertical type gas engine, or alternatively, Diesel oil engine, of 500 B.H.P. capacity, suitable for connecting by rope drive to an A.C. motor and a D.C. generator mounted on one shaft, and running at 500 R.P.M., and (2) a direct-coupled set consisting of a vertical type gas engine, or alternatively, Diesel oil engine, and D.C. generator of 800 KW. capacity at 550 volts. Separate tenders to the Town Clerk, Dunedin. A deposit of £100 is required with each tender, to be increased by the successful tenderer to £500. A copy of the specification and form of tender, &c., may be seen by British makers at the Commercial Intelligence Branch of the Board of Trade.—*Board of Trade Journal.*

Pontypridd.—September 12th. Water-tube boiler and Foster superheater for the U.D.C. See "Official Notices" September 1st.

Roumania.—November 19th. The lighting of the town of Tulcea by electricity. "Mairie de Tulcea," Tulcea.

Spain.—September 30th. The Spanish Ministry of Posts and Telegraphs in Madrid are inviting tenders for the concession for the establishment, and working during a period of 15 years, of a telephone exchange in the town of Orense.

The "Junta especial de Subastas, Ministerio de Marina," Madrid, invites tenders for the supply of two radio-telegraphic installations, one of a naval type, and the other capable of being carried by a landing party. The upset price is put at 42,000 pesetas (about £1,550), and a deposit of 2,200 pesetas (about £80) will be required with each tender. Local representation is essential.—*Board of Trade Journal.*

Sweden.—September 15th. The Harbour Authorities at Norrköping require some electrical windlasses, and request possible suppliers to make tenders. Tenders, marked "Anbud a leverans av elektriska förhalningsspel," to "Hamnstyrelsen, Norrköpings Stads Byggnadskontor," Norrköping. A copy of the specification (in Swedish), together with a translation, may be seen at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, London, E.C., where also the name of a trader through whom firms might submit their offers may be obtained.—*Board of Trade Journal.*

Swinton and Pendlebury.—September 9th. Electric cables, joint boxes, compound, &c., for the U.D.C. See "Official Notices" September 1st.

Wishaw.—September 11th. Carbons for Oriflamme arc lamps for the T.C. See "Official Notices" September 1st.

CLOSED.

Bridlington.—The T.C. has accepted the tender of Messrs. John Watt & Co., Ltd., of Hull, for coal for the electricity works.

Great Eastern Railway.—Messrs. Royce, Ltd., of Trafford Park, have been awarded an order by the Great Eastern Railway for 11 electrical capstans of the "Royce" patent free bollard type and spares for use on the company's wharf and goods yard at Blackwall. The order also comprises 10 electrical jib cranes, two electrical hoists and spares.

Halifax.—The Tramways Committee has accepted the tender of Messrs. Murgatroyd & Horsfall, jewellers, to supply and fix in Commercial Street an electric master clock, at £4 10s.; and to supply and fix at Union Street, Cow Green, and Waterhouse Street, receiver clocks at £3 3s. each.

New Zealand.—The British General Electric Co., Ltd., Harbour Street, Wellington, have secured the contract for the electrical plant, switchboards and motor pumps for the Gisborne Borough Council. The company have also supplied the Wellington City Council with a quantity of 1,000-C.P. Osrams, these being, we understand, the largest lamps introduced into the Dominion.

Salford.—The Corporation, on Monday, accepted the tender of the Lancashire Electrical Co. for the complete installation of intercommunication telephones (34 stations) in the Salford Town Hall and New Annexe.

Stalybridge.—The contract for the installation of electric light in St. Paul's Church has been let to Messrs. Drake & Gorham, Ltd.

Stockton-on-Tees.—The T.C. has accepted the following tenders:—

Richardsons, Westgarth & Co., Ltd., Hartlepool.—Mixed pressure turbine combined with a Siemens direct current 400 to 500-KW. generator, £2,929.
Klein Engineering Co. (1908), Ltd., Manchester.—Cooling tower.
T. Sugden, Ltd.—Superheaters.
Drake & Gorham.—Switchgear.

Stoke-on-Trent.—The T.C. has accepted the tender of Mr. Wardle, of Longport, for the new power station, at £5,120; and that of Messrs. Grant & Sons, of Burslem, for the extension of the Burslem Electricity Works, at £615.

Wakefield.—The City Electric Light Committee has accepted the the tender of Messrs. Higgins & Pashley, for the supply of a weighbridge to the electricity works, at a cost of £41 10s.

Warrington.—The T.C. has accepted the tender of Messrs. Matthews & Yates, Ltd., for the supply of an induced draught plant.

Wigan.—The E.L. Committee of the T.C. has accepted the tender of Messrs. Duckham & Co., Ltd., for oils for a year for the electricity works.

NOTES.

Olympia Electrical Exhibition.—The Conference of Chief Officials of the Electric Supply Companies of London, assisted by many provincial supply companies and certain of the London Borough Councils, have taken two large spaces on either side of the central gangway. One of these stands will be fitted up as an Inquiry Bureau, and will contain an important exhibit from the Publicity Committee. The other stand will be arranged as a Demonstration Room, with seating accommodation for about 50 visitors, the object of the Conference being that the fullest opportunity should be afforded for practical demonstrations of the latest developments in electric lighting, cooking, cleaning and other devices. Exhibitors are invited to communicate with Mr. F. J. Walker, Hon. Secretary of the Conference, 19, Carnaby Street, W., with a view to taking advantage of this arrangement, which cannot fail to be beneficial to all parties concerned. No charge will be made for the use of this room. The Conference are also arranging for a series of popular competitions, which will be open to all visitors to the Exhibition, and attractive prizes will be offered for the best replies received. Full particulars of these competitions will be shortly announced.

We are asked to state that the management of the Exhibition will be happy to send any contractors pictorial posters of the Exhibition on hearing from them, and on consideration of such contractors exhibiting these bills in their windows, they will be entitled to two complimentary tickets to the Exhibition. The greater the public attendance at the Electrical Exhibition the more the industry may expect to benefit generally, and we would therefore urge all contractors to assist to the utmost of their power in giving the Exhibition full publicity in their windows and shops and in conversation with their clients.

German Labour Troubles.—Reuter's Berlin representative states that at a meeting of Berlin electric fitters held on August 31st, it was decided to approve the resolution previously adopted at a meeting of the men's delegates, to the effect that the tactics hitherto observed should be modified, and that agreements on the conditions of labour should in future be concluded with each individual firm instead of between the different organisations of employers and employed.

New Effect of Electricity.—A correspondent writes:—"When switching off the arc lamps in Goring Road, Llanelly, recently, a young man named Lee, in the employ of the local electric light company, received a severe shock from the current. As a result he was struck dumb, and for ten days since has been unable to speak. He is otherwise physically well, and hopes are entertained that he will soon recover the lost faculty." We are pleased to add that he regained the power of speech on Sunday last.

Appointment Vacant.—Shift engineer for the electricity works of the Public Works Department, Southern Nigeria (£250). See our advertisement pages in this issue.

Electrical Publicity.—The Electric Supply Publicity Committee has made a further issue of publicity matter. There is one point of particular excellence, and that is the coloured drawing which figures on the front cover of the booklet and on the mail card. This is a design by the well-known artist, Mr. Cecil Aldin, who has obtained such widespread popularity as a painter of dogs in their various moods. In the present instance, he has two dogs in a very happy moment in front of an electric radiator. The booklet is issued at a very convenient moment, as it will be just in time for sending out with the September quarter's accounts. The inside of the heating booklet is equally excellent; the booklet is just the thing to put in the hands of consumers. The mail card, on which the illustration has been reproduced, has the reverse side left blank, so as to be used for correspondence, and would form a very attractive advertisement. The issue also includes a four-page circular, in which the safety of electric light comes to the fore-front, as against certain disastrous gas accidents quoted from the Press; and a power booklet of good size, got up on the most approved lines.

A Charmed Circle.—A correspondent writes:—"Recently a 'short' leet' of a round baker's dozen were fore-gathered in the civic hall of a certain town in the shire of broad acres. Prior to individual examination by the elected (more or less) great unpaid, as was but natural on so auspicious an occasion, discussion turned upon central station matters. Almost needless to relate, the consensus of tone was of a decidedly pessimistic character. Conversation then, as a matter of course, drifted to the prevailing strike, one of the 'hopefuls' remarking that two absentee selected candidates had probably got hung up somewhere on the line.

"At that moment the door of the waiting-room was opened, the incomer being a gentleman bearing obvious signs of recent travel. The room was of the usual 'board' type—long official table, conventional uninviting chairs, &c. Advancing towards the table, the new arrival, addressing the ring of candidates in apologetic tone, 'regretted his inability to be on time through delay of trains owing to railway dispute.' Imagine the consternation of the embarrassed station man on hearing the round of hearty laughter which greeted his explanation. The delicate irony of the situation was that a meeting of shift engineers and mains men should have been mistaken for a committee of town councillors. One usually associates obesity and senility with our civic representatives. Some station men may perhaps before long be included in the latter category, and 'shift' to another stage, as Shakespeare puts it—the last stage of all; but whilst things in the station world remain as at present the likelihood of any of the fraternity being suspected of approaching embonpoint seems rather remote."

Nitrogen from the Air.—According to *Affärsvarlden*, a company has recently been formed at Stockholm for the exploitation of a new electrical process for extracting atmospheric nitrogen. The promoters of the company are some of the most prominent men in financial and commercial circles, and the capital is 3,000,000 kroners (£166,667), which can be increased later. The new process has been invented by the engineers Th. Thorsell, C. Bjorne and B. Lundin. During the first year the company intends to have the process thoroughly tested by means of experiments, which are going to be carried out on such a large scale as to form a basis for the continuation on commercial lines. After the necessary experience has been gained, a large factory is to be built at Gothenburg.

The chief difference between this new process and those already in existence, and used in Sweden, and especially in Norway, is that the former is not altogether dependent on a large supply of electrical energy, but requires a comparatively small amount. This advantage explains the possibility of deriving the power for the new factory from the Trollhättan Waterfalls, which is by no means very cheap. On the other hand, Gothenburg offers such facilities with regard to shipping as no other Swedish port, and for this reason, with an export trade in view, this place has been chosen as the centre of this new industrial undertaking.

Train Lighting in Germany.—According to information emanating from railway circles, the management of the Prussian-Hessen State Railways seems disposed to approach more closely the question of introducing the electric light in passenger trains. As a result of the disasters caused by the escape of gas, the sleeping cars in past years have been equipped with the lighting system owned by the Train Electric Lighting Co., of Berlin. Each coach is provided with a dynamo driven by belt from the axle, of the Rosenberg type, and a battery is provided for furnishing light when the train is at a standstill.

Electric Ambulances.—According to the *Standard*, the Port of London Authority will the week after next put into service the four electric ambulances intended for first aid use on the London Docks.

Annual Sports.—The Robertson and Osram Social and Athletic Club held their sixth annual sports at the Latymer Upper School Grounds, Wood Lane, Shepherd's Bush, on Saturday afternoon last. The programme of events included flat racing for girls, men and veterans respectively, egg-and-spoon race, skipping races, tug-of-war, three-legged, obstacle and wheel-barrow races. The judges were Messrs. C. Wilson, F. P. Driver, E. G. Sheppard, G. Jessop and C. Beaven. Mrs. C. Wilson distributed the prizes. The Middlesex Military Band played selections during the afternoon and at dusk for dancing. The hon. secretaries were Messrs. G. H. Freeman and L. Jordan.

Educational Notes.—City of London College.—The new term commences on October 2nd; classes are provided in physics, &c. See our advertisement pages to-day.

University College, London.—The new session begins on October 2nd. Degree and diploma courses are provided, and special courses for students partially trained elsewhere. Postgraduate work is also arranged for, and an entrance scholarship (120 guineas) is open for competition. See our advertisement pages to-day.

Borough Polytechnic Institute, S.E.—The institute reopens on September 25th. Instruction is given in electrotechnics under Dr. J. Henderson. See our advertisement pages to-day.

Enamel Insulated Wires.—The steady progress that is being made in the development towards perfection of enamel insulation for wires is well exemplified in the third edition of a pamphlet on the subject recently issued by Messrs. Connolly Bros., Ltd., of Blackley, Manchester. The makers state that their enamel is unaffected by alternations of moisture and dryness, by sunlight, and by a permanent temperature of 300° F., while it can be exposed temporarily to a temperature of 600° or 700° F. without injury, and to 400° F. for several hours. The enamel is also proof against alkalis and other powerful solvents, including alcohol, and electrolysis. What has especially caught our attention, however, is the fact that these wires are now being put forward not only for winding the coils of instruments, arc lamps, transformers and field magnets, as well as for telephone and bell circuits, but also for electric lighting. For this purpose the enamelled wires are double cotton-covered and compounded, twinned, and braided with cotton impregnated with flame-resisting compound. Such wires, it is stated, have withstood pressures up to 8,400 volts A.C. when dry, and 2,000 volts A.C. when immersed in water for eight days. The makers recommend their use for circuits up to 220 volts, and inform us that the Bradford Corporation Electricity Department, after prolonged investigation, recommends its adoption, in conduit, for electric lighting circuits. We anticipate, therefore, further interesting developments in this direction, and congratulate the firm on the progress already accomplished.

Creosoting Timber by the Rüping Process.—Messrs. Richard Wade, Sons & Co., Ltd., of Hull and Staddlethorpe, have installed extensive plant at Staddlethorpe to carry out the new Rüping process of creosoting timber. This process is a German invention, and, judging by its success on the Continent, it bids fair to supplant the existing creosoting processes. At the invitation of the directors of the firm, one of our representatives visited on Tuesday the extensive timber yards of Messrs. Wade and witnessed some interesting demonstrations. There was a large and representative gathering of commercial men and others interested, including Mr. James Sinclair, of the National Telephone Co.; Mr. E. Roberts, of the General Post Office; Mr. Morgan, of the G.P.O. stores; Mr. Johns, of the London and South-Western Railway; Mr. Bricknell, Hull assistant city engineer; Mr. T. Holmes, manager of the Hull Corporation Telephones, and others.

On arriving at the works, the visitors were met by Mr. E. S. Wade and Mr. Christopher Wade, and shown over the yards and premises. For the demonstrations, various shapes and kinds of wood were selected, such as redwood, poles, timbers, sleepers, fencing, paving blocks and whitewood battens and boards. These were all weighed and measured and then sealed up in a cylinder, where they were subjected to an air pressure of about 50 lb. per sq. in., and then the cylinder was filled with creosote, the air pressure being maintained. Next a pressure of 80 lb. per sq. in. was put on, after which the pressure was released and the cylinder opened. The timber was then taken out and reweighed, showing the amount of oil remaining in it. Various pieces of the wood were cross-cut, and showed a remarkable penetration of oil, nearly to the centre. This, it was stated, was impossible in the old method except at a great cost, and this also applied to the white-wood, into which it used to be practically impossible to inject the oil. One of the things which impressed the visitors was the extreme cleanliness of the wood. It was quite dry and clean to handle, and not dirty and clogged with oil as is generally the case with creosoted wood. By this method, it was clearly shown, the cost is very greatly reduced, for waste of the preserving liquid is entirely avoided, whilst better results are obtained, it seems, than by the old method. The firm is the only one that has adopted the process in this country, though experiments have been made in London for some time past.

The visitors were entertained to lunch at the conclusion of the demonstration, and Mr. Johns (London and South-Western Railway Co.) thanked the directors for the opportunity of seeing the demonstrations.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—Mr. J. J. McKenna, shift engineer at the power station of the Lancashire Electric Power Co., has been appointed shift engineer to the Midland Electric Corporation, Ltd.

Mr. E. C. Lloyd, second assistant mains superintendent, Wallasey Corporation electricity works, was presented with a copper fire suite, by the staff and employés of the department, on the occasion of his marriage.

Mr. H. R. Campion, borough electrical engineer at Dewsbury, whose serious illness we recently announced, is slowly improving, but it will be some weeks before he will be able to resume his duties.

The staff at the Derby Corporation electrical department has presented a set of decanters to Mr. Geo. Dearle on his marriage.

Tramway Officials.—The staff of the Sheffield Corporation tramways have presented a silver tea tray to Mr. H. E. Yerbury, chief engineer, as a wedding gift.

Mr. A. N. Batley, who is leaving Yarmouth to take up an appointment in the Swindon Corporation tramways department, has been presented by the staff with a purse of gold, and a Gladstone bag.

General.—Mr. A. McAdam, assistant electrical engineer of the Ordnance Gun Carriage Factory, Jubbulpore, India, will shortly resign his position.

We regret to learn that Mr. Walter Dunn, who has rendered such splendid and faithful service as secretary of the Junior Institution of Engineers during the past 27 years, is about to retire from that position. We wish that the Council's pressure upon him to reconsider his decision had been more successful, but "considerations of health," and these alone, have compelled him to relinquish the office, into the duties of which he has so long thrown himself heart and soul.

Obituary.—Mr. James Dodimead.—We regret to learn that Mr. James Dodimead, senior partner of Messrs. James Dodimead & Sons, passed away on Wednesday.

CITY NOTES.

Underground Electric Railways Co. of London, Ltd.

The directors' report for the half-year ended June 30th, states that the net revenue from investments and properties (including general interest), after deducting general expenses, amounted to £106,105, and the amount receivable under guarantee on Metropolitan District Railway assented first preference stock was £2,687. The net income from the operation of the power house was £45,472; the interest on £1,000,000 4 per cent. first power house debentures, and a proportion of commission, discount and expenses incurred in connection with the issue, required £20,870, leaving a surplus from the power house of £24,602, making the revenue total £133,394. The service of the £1,000,000 5 per cent. prior lien bonds required £26,549; the service of the £2,818,700 4½ per cent. bonds of 1933 required £67,349; leaving a surplus over half-yearly charges of £39,496, which amount will be applied as follows: Interest at the rate of 1¼ per cent. per annum on £4,928,050 6 per cent. income bonds of 1948, £36,960; income-tax, £2,289; leaving a balance to reserve applied in reduction of the accumulated revenue deficiencies of £246.

The income from investments for the six months shows an increase of £15,678 (about 17 per cent.) over that for the corresponding half-year of 1910. The directors note with satisfaction that the Metropolitan District Railway Co. has paid for the last half-year a dividend at the full rate of 4½ per cent. per annum on its first preference stock, and that consequently the company is now deriving the full benefit of the arrangement under which it guarantees the dividend on the Metropolitan District Railway assented first preference stock. The company received on balance in respect of last half-year the sum of £2,686, whereas for the corresponding half-year of 1910 the amount paid by the company was £1,343.

The traffic of the railway companies and the London United Tramways, Ltd., in which the company is interested, is increasing satisfactorily.

The eighth Parsons turbine has now been installed in the power house, and is in operation. The net output of electric energy during the half-year was 69,636,800 KW.-hours, as against 63,627,200 KW.-hours during the corresponding period of 1910.

London Electric and District Railway Acts.—The London Electric Railway Bill referred to in the last report received Royal assent on June 2nd last. The railway company has let the contracts in connection with the construction of the Charing Cross and Paddington extensions and actual construction has been started. It is hoped that these works will be completed within 18 months. The Metropolitan District Railway Bill referred to in the same report also received Royal assent on the June 2nd last. The powers conferred by this Act, whereby the Lots Road power house undertaking is to be purchased by the joint committee of the Metropolitan District and London Electric Companies and leased to the two railway companies, were fully explained in the circular issued to the shareholders and holders of 6 per cent. income bonds of the company on June 9th last. A provisional agreement has been executed stating the terms on which the power house will be transferred to the joint committee and leased to the two railway companies as on and from January 1st next.

£1,250,000 London Electric Railway 4 per cent. preference stock was sold during the half-year for delivery on September 1st next. The proceeds will be used towards the redemption of the entire series of £1,000,000 5 per cent. prior lien bonds on that date. The proceeds of £2,200,000 Metropolitan District and London Electric Railways joint power house rent charge stock which has been sold for delivery on January 15th next will constitute the purchase price for the Lots Road power house undertaking above referred to, and will be used to redeem on that date £1,000,000 4 per cent. power house debentures and £1,088,700 4½ per cent. bonds of 1933.

Stocks, shares and other property stand in the books at £11,991,917, and consist of stocks and shares in associated companies, consols, and lands and buildings other than power house property. The decrease of £23,717 mainly results from the sale of £25,000 London Electric Railway debenture stock.

The power house depreciation fund at the end of the half-year was £171,524. The interest of the company in this fund, as well as in the special maintenance fund amounting at the end of the half-year to £3,051 in cash, being included in the power house sale, will be transferred with the power house undertaking to the Metropolitan District and London Electric Joint Committee.

Companies Struck Off the Register.—The following companies have been struck off the Register, and are accordingly dissolved:—

Aberdare Electric Lighting Co., Ltd.
Albion Battery Co., Ltd.
Buenos Ayres Electric Light Co., Ltd.
General Heating and Lighting Co., Ltd.
Heswall District Power Co., Ltd.
Private Wire and Telephone Installation Co., Ltd.
Via Eastern Code Co., Ltd.

Claud Hamilton, Ltd.—The general meeting was held on August 30th at Glasgow. Mr. Alex. J. Fergusson, C.A., chairman of the board, presided, and moved the adoption of the report, which recommended the payment of a dividend of 10 per cent. on the ordinary capital of the company, after making adequate provision for depreciation, carrying substantial amounts to the various reserve funds of the company and paying the dividend on the 5 per cent. preference shares. The motion was seconded by Mr. Claud Hamilton, and unanimously adopted. Mr. Claud Hamilton was re-elected a director, and the auditor was re-appointed.

South Metropolitan Electric Light and Power Co., Ltd.—Warrants for dividends on the company's 7 per cent. cumulative first and 6 per cent. cumulative second preference shares for the half-year ended June 30th, 1911, have been posted.

Stock Exchange Notices.—Application has been made to the Committee to allow the following securities to be quoted in the Official List:—

Hastings and District Electric Tramways Co., Ltd.—268,235 ordinary shares of 10s. each fully paid, Nos. 130,001 to 398,235, and 80,000 6 per cent. cumulative preference shares of £1 each fully paid, Nos. 1 to 80,000, partly in lieu of the preference shares of £5 each now quoted.

The Committee has ordered the undermentioned to be quoted in the Official List:—

Marconi's Wireless Telegraph Co., Ltd.—Further issue of 37,900 ordinary shares of £1 each fully paid, Nos. 428,776 to 466,675, and 227,011 7 per cent. cumulative participating preference shares of £1 each fully paid, Nos. 500,001 to 727,011.

Newcastle and District Electric Lighting Co., Ltd.—The directors have declared an interim dividend at the rate of 3 per cent. per annum for the half-year to June 30th.

Electric Supply of Victoria, Ltd.—The directors' report, as abstracted in the *Financier*, states that the accounts for the year to March 31st, after payment of debenture interest, show a profit of £11,340. After adding £6,212 brought forward and deducting £5,599 paid on account of the preference dividend due and £4,722 for the debenture stock redemption account, there remains a credit balance of £7,231. The preference dividend in arrears amounts to £16,211.

Davis & Timmins, Ltd.—The directors have declared an interim dividend at the rate of 6 per cent. per annum (7½d. per share), less income-tax, on the ordinary shares, for the half-year to June 30th.

Globe Telegraph and Trust Co., Ltd.—The directors have declared an interim dividend of 2s. per share, free of income-tax, on the ordinary shares for the past quarter.

Dumbarton Burgh and County Tramways Co., Ltd.—The directors report that the accounts for the year ended July 31st show an available sum, after providing for debenture interest and including £3,010 brought forward, of £8,468, out of which the directors recommend payment of the dividend on the preference shares, leaving £2,768 to be carried forward.

British Electric Transformer Co., Ltd.—The directors have declared an interim dividend at the rate of 6 per cent. per annum (7½d. per share), less income-tax, on the ordinary shares for the half-year to June 30th.

Sao Paulo Tramway, Light and Power Co., Ltd.—A quarterly dividend at the rate of 10 per cent. per annum is announced, payable October 2nd.

Oxford Electric Co., Ltd.—The directors have declared a dividend at the rate of 6 per cent. per annum, less tax, on the ordinary shares for the half-year to June 30th.

Continental.—France.—A company has just been formed at Flines-les-Racher (Nord) with the title La Société Electrique de Flines-les-Racher, to establish a small central electric lighting station in the town.

Russia.—The report of the Compagnie d'Electricité de Varsovie, of Warsaw and Paris, for the last financial year shows a net profit of 460,167 roubles, as compared with 301,896 roubles in the preceding 12 months. The dividend is being increased from 2 to 4 per cent.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	Receipts for the fortnight. £*	No. of wks.	Total to date. £	Total to date. £*	Route miles open.	Inc.
Aberdeen	Aug. 30	3,261	— 13	13	21,680	+ 347	..	..
Ayr	Sept. 2	764	+ 55	16	6,906	+ 88	8	..
Bath	„ 2	2,073	+ 73	35	29,882	+ 1,154	..	..
†Belfast	Aug. 25	4,498	+ 524	21	97,139	+11,928	40	3
Birkenhead	Sept. 3	2,312	+ 16	22	26,188	+ 961	13·7	..
Birmingham Corp.	Aug. 26	17,018	+3,655	21	168,521	+25,414	56·4	..
Blackburn	..	..	..	..	..	..	..	..
†Blackpool Corp.	„ 24	2 570	— 157	..	36,747	+ 3,565	..	..
Blackpool-Fleetw'd	Sept. 2	3,481	+ 417	9	16,059	+ 1,251	..	..
†Bolton	Aug. 27	2,449	+ 53	22	55,794	+ 4,186	26	..
Bournemouth	„ 30	4,790	+ 39	22	42,731	— 1,722	21·9	..
Bradford	„ 26	11,844	+1,324	21	121,290	+10,187	56	1·8
Brighton	Sept. 3	2,769	+ 242	22½	26,187	+ 1,808	9·5	..
Bristol	„ 1	14,620	+2,153	..	..	..	..	..
Brit. Elec. Trac. Co.								
Airdrie	Aug. 25	461	+ 26	34	7,380	+ 67	3·65	..
Barnsley	„ 25	583	+ 77	„	6,972	+ 404	..	..
Barrow	„ 25	928	+ 305	„	10,278	+ 1,077	5·37	..
Devonport	„ 25	1,214	+ 285	„	18,812	+ 2,497	8·85	..
Gateshead	„ 25	2,199	+ 176	„	35,829	+ 2,016	11·25	..
Gravesend	„ 25	481	+ 13	„	7,261	+ 205	6·5	..
Greenock	„ 25	1,782	+ 265	„	24,584	+ 3,146	7·25	..
Hartlepool	„ 25	697	+ 29	„	9,260	+ 784	6·72	..
Kidderminster	„ 25	308	+ 22	„	4,114	+ 279	..	..
‡Leamington	„ 25	455	— 6	„	6,060	+ 332	..	..
Merthyr	„ 25	451	+ 18	„	7,140	+ 134	2·9	..
Metropolitan	„ 25	17,958	+2,012	„	298,653	+46,782	22	..
Middleton	„ 25	1,099	+ 319	„	11,878	+ 1,046	8·5	..
Mid. Joint Com'tee	„ 25	8,654	—3,474	„	190,829	— 4,413	..	..
Oldham—Ashton	„ 25	1,405	+ 175	„	19,226	+ 734	9·18	..
Peterborough	„ 25	396	+ 21	„	4,355	+ 427	5·81	..
Potteries	„ 25	3,806	+ 77	„	65,252	+ 6,380	29	..
Rothesay	„ 25	1,277	+ 187	„	8,037	— 16	2·75	..
Southport	„ 25	870	+ 118	„	10,622	+ 444	8·17	..
S. Metropolitan	„ 25	2,207	+ 164	„	29,879	+ 1,686	..	..
Swansea	„ 25	2,557	+ 108	„	39,050	+ 2,413	12·5	..
Tynemouth	„ 25	1,065	+ 69	„	9,531	+ 356	3·75	..
Weston-s-Mare	„ 25	1,006	+ 144	„	6,076	+ 641	3	..
‡Worcester	„ 25	659	— 36	„	10,093	+ 462	5·75	..
Wrexham	„ 25	252	+ 35	„	3,443	+ 159	..	..
Yorks. Wool. Dist.	„ 25	2,341	+ 201	„	35,876	+ 2,575	17	..
Miscellaneous	„ 25	602	+ 73	„	7,821	+ 346	..	..
Burnley	Sept. 2	2,812	+ 354	..	..	..	11·7	1
Burton-on-Trent	„ 3	627	+ 35	22	6,744	+ 624	6·6	..
Bury	„ 3	2,646	+ 248	22½	29,971	+ 3,106	22·5	..
Cardiff	Aug. 19	5,569	+ 680	20	22,132	+ 5,047	..	..
Chatham and Dist.	„ 31	1,924	— 70	35	30,037	+ 310	15	..
Cork	„ 31	1,104	+ 68	35	17,622	+ 505	9·9	..
Croydon	„ 21	3,648	+ 144	..	40,190	+ 3,425	..	..
Darlington	Sept. 2	447	+ 33	23	5,136	+ 534	..	..
Darwen	„ 1	552	+ 67	22	6,073	+ 543	4·36	..
†Dover	Aug. 19	386	— 32	20	5,652	+ 850	4·7	..
Dublin	Sept. 1	13,056	— 360	..	65,339	+ 9,622	54·2	..
Dundee	Aug. 30	2,388	— 200	15½	18,515	— 397	15	..
East Ham	Sept. 2	2,140	+ 26	22½	24,659	+ 1,350	7·9	..
Exeter	„ 1	783	+ 50	22	8,219	+ 707	5·5	..
Glasgow	„ 2	88,450	+4,669	..	251,275	+17,379	98	·75
Hastings	Aug. 31	3,154	+ 99	..	..	..	..	..
Huddersfield	..	..	..	..	..	..	..	..
Hull	Sept. 2	5,654	+ 82	22	63,468	+ 2,960	14·5	..
Ilkeston	Aug. 31	264	— 16	22	2,994	+ 110	..	..
Ipswich	Sept. 2	1,144	+ 99	22	10,894	+ 694	10·5	..
Kilmarnock	„ 2	328	+ 20	16	2,858	+ 312	4·25	..
Lancashire United	Aug. 30	3,004	+ 454	35	47,341	+ 1,726	39	..
Leeds	„ 26	15,501	+1,361	21	162,817	+11,684	108	..
Leicester	..	..	..	..	..	..	..	..
Leith	Sept. 2	1,365	+ 146	15½	11,352	+ 999	8·7	..
†Liverpool	Aug. 19	8,333	—3,169	33	378,783	+12,296	116	2·5
‡L.C.C.	„ 28	82,482	+1,200	..	985,469	+59,701	142	6
London United	Sept. 2	14,153	+ 411	..	284,298	+ 9,897	..	..
Lowestoft	..	..	..	..	..	..	3·5	..
Manchester	„ 2	32,006	+1,575	22	364,414	+21 848	183	..
Newcastle	„ 2	8,382	+ 830	..	96,026	+13,338	14·5	..
Newport	„ 2	1,375	— 51	22	16,416	+ 891	14·5	..
†Oldham	„ 3	1,892	+ 123	..	45,261	+ 1,787	23·5	·5
Portsmouth	..	..	..	..	..	..	15·25	..
Preston	Aug. 30	1,647	+ 73	22	17,731	+ 1,365	..	..
Salford	„ 28	9,868	+ 861	21	106,855	+ 6,007	..	..
Sheffield	Sept. 5	12,511	+ 626	..	148,822	+10,154	40	..
Southampton	Aug. 30	2,602	+ 375	22	28,589	+ 3,762	22	..
Southend-on-Sea	„ 30	2,290	+ 346	22	17,597	+ 2,538	..	..
South Shields	Sept. 2	1,632	+ 98	22	14,741	+ 1,845	..	..
Swindon	Aug. 30	350	+ 42	22	3,594	+ 433	..	..
Tyneside	„ 30	1,348	+ 426	9	5,245	+ 644	..	..
Wallasey	Sept. 2	2,313	+ 273	22	26,370	+ 4,148	..	..
Walthamstow	„ 2	1,581	+ 69	22	18,374	+ 1,627	9	..
West Ham	Aug. 31	9,914	+ 491	22	61,289	+ 6,184	15·25	..
Wolverhampton	„ 30	1,989	+ 180	22	22,389	+ 1,419	25	..
Cen. London Rly.	Sept. 2	7,823	—1,852	9	38,685	— 8,175	6·32	..
City & S. Lon. Rly.	„ 3	5,969	— 108	9	27,168	— 456	7·26	..
Dublin-Lucan Rly.	„ 1	841	— 31	9	1,580	— 51	7	..
G.N. and City Rly.	„ 2	2,608	— 43	9	12,110	+ 246	3·5	..
L'pool Overh'd Rly.	„ 2	2,921	+ 63	..	13,780	+ 949	6·8	4·3
Llandudno-Col. Bay	„ 1	1,450	+ 48	39	11,899	+ 467	..	..
London Elec. Ry. Co.	„ 2	21,210	+ 45	9	104,305	+ 1,475	21·25	..
Mersey Railway	„ 2	8,314	— 498	9	15,965	— 1,602	4·5	..
Metropolitan Rly.	„ 3	30,962	— 733	9	144,577	— 3,950	24·5	..
Met. District Rly.	„ 2	19,328	+ 613	9	94,308	+ 4,228	24	..
Anglo-Argentine	„ 2	93,681	+5,819	..	1,702,558	+158,816	..	..
§Auckland	July	16,199	+1,462	..	..	..	23·8	·6
Bombay (B.E.T.)	Aug. 4	5,519	+ 478	33	88,222	+ 5,397	..	..
Brisbane	..	..	..	..	..	..	..	..
Brit. Columbia Rly.	..	..	..	..	..	..	..	..
Calcutta	Sept. 2	7,515	+ 154	..	..	..	..	..
Cape Electric T.Ld.	..	..	..	..	..	..	..	..
§Kalgoorlie, W.A.	July	8,320	..	..	23,784	..	20·5	..
§Lisbon	..	..	..	..	..	..	..	..
Madras	Aug. 15	1,508	+ 144	..	22,040	+ 1,861	..	..
§Montevideo	Aug.	24,015	+1,759	..	350,272	+14,658	..	..
Perth (W.A.)	Sept. 1	3,091	..	..	56,308	+11,883	22	..

* Compared with the corresponding period of 1910. † One week only.
‡ Includes horse, steam and other receipts. § One month.

STOCKS AND SHARES.

Tuesday Evening.

Stock Exchange markets have once more been subjected to a series of harassing incidents. Of these, the largest looming is Morocco, which has appeared in the financial firmament as a disturbing factor of cumulative intensity. Then there have been troubles in the markets, and the continued unsettlement which is still felt with regard to labour on some of the leading railway lines. All things considered, there is little to induce fresh business, and what trade remains is mainly of the investment order, such as goes on steadily all the year round.

Home Railway stocks had a severe shake-out again, which lowered prices of the steam stocks very substantially. The traffics of the strike fortnight have, of course, been bad. This was generally expected, although, perhaps, the losses are more than anticipation looked for. But besides the takings, the domestic trouble in the Stock Exchange referred to in the preceding paragraph, brought about severe liquidation, which swept Home Railway stocks on to lower levels. One of the chief sufferers has been Brighton Deferred Stock, which got down to 93½, some 20 points lower than it stood about Easter time. A partial recovery ensued upon the settlement of the difficulty on the Great Eastern Railway, which threatened to become acute last week, but on balance many stocks have fallen. Amongst the latter are included Metropolitan Consolidated stock with a drop of 1½, Surplus Lands and District Ordinary, which fell a point each, and Underground Electric Railways income bonds, which also lost 1. City and South London Ordinary went back ½, Central Londons are steady, the Deferred retaining its recent improvement.

British Electric Traction 5 per cent. Debenture eased off to 94½, and the Preference shares have not been a particularly good market, showing ⅛ loss. Metropolitan Electric Tramways Debenture fell ½, and Bath Trams Preferred Ordinary went back to 3s. 1½d., marking a fall of $\frac{1}{16}$. These are the only noteworthy changes amongst Home Railway and Tramway issues.

In the foreign list, British Columbia Deferred fell 2, and the market here is not so firm as it has been. The Mexico group also is easier, Mexico Trams going back 3, and Rio Trams falling ¾, while Sao Paulos reacted a point. The Bond issues are steady, although a trifle irregular as regards the price movements, which are quite small. Rather a feature in this market is a further rise of $\frac{3}{32}$ in Perth Electric Tramways Ordinary shares, which have gone up to $\frac{15}{16}$ *ex* dividend, showing a rise of 4s. 1½d. during the past fortnight.

Mexican light and power issues went down on news of riots having broken out in connection with the elections in that country. The Common fell 1; both the Preferred and the 1st Mortgage Bonds are easier. Monterey Bonds lost ½, and it is further suggested that the easier tendency of such securities as this is due to the reason already mentioned here, namely, that holders of such issues have lately been obliged to sell, in order to pay losses incurred elsewhere. Canadian General Electric Common shed a point, and there are a few *ex* dividend markings which have left prices very little down on balance.

Amongst the Telegraph and Telephone stocks and shares, the feature is a steady demand for the Eastern issues. Eastern Ordinary is up 1, Eastern Extensions rose ½, following upon their improvement of last week. The market has got into a position of considerable strength, and appears to be attracting more investment attention than it has done for some time past. In the face of the way in which Marconi shares have also been rising, this is an indication that the Marconi scare may now be considered practically at an end, so far as the old cable companies are concerned. Marconi shares themselves are $\frac{1}{16}$ easier, and another speculative stock—Anglo-American Telegraph Deferred—show a fall of ½, although the company's other stocks are unchanged. Directs are down ¼; West India and Panama lost $\frac{1}{16}$. Globe Telegraph and Trust Ordinary reacted a trifle. National Telephone Deferred and Third Preference sagged slightly.

India-Rubber Co.'s shares are a good feature, with an advance of 20s. Beyond this, there is practically no quotable alteration, except such as is provided by *ex* dividend markings amongst the manufacturing issues. The rubber market shows a good deal of strength, and it has withstood the elements of depression in other departments rather surprisingly well, for which, no doubt, one reason is to be found in the fact that the market is well buttressed by the bear account.

Amongst English Electricity Supply shares, Urban Preference and Edmundson's Preference have returned to the same level of 2¼ middle, showing losses on the week of ¼ and ⅛ respectively. There is, of course, very little market in either. County of London Preference lost ⅛. A slight demand for Central Electric 4 per cent. Guaranteed Debentures put the price a point higher, raising it to 100½. London Preference, South Metropolitan Preference, and City of London shares are all *ex* dividend, the deductions being reflected in the prices, and beyond this there is practically nothing of interest in the market.

SHARE LIST OF ELECTRICAL COMPANIES.

ENGLISH ELECTRICITY SUPPLY AND POWER COMPANIES.

NAME.	Stock or Share.	Dividends for 1909.	Dividends for 1910.	Closing Quotations Sept. 5th.	Rise + or Fall —	Present Yield p.c. £ s. d.
Bournemouth & Poole, Ord.	10	5½	5½	7¾ — 8¼	..	6 5 9
Do. 4½ % Pref.	10	4½	4½	8¾ — 9¼	..	4 12 4
Do. Second 6 % Pref.	10	6	6	10 — 10½	..	5 14 3
Do. 4½ % Deb. Stock	Stock	4½	4½	101 — 103	..	4 7 5
Brompton & Kensington, Ord.	5	10	10	7¾ — 8¼	..	6 1 3
Do. 7 % Cum. Pref.	5	7	7	7⅛ — 7⅝	..	4 7 6
Central Electric Supply, 4 % Guar. Deb.	100	4	4	99 — 102	+1	3 18 5
Charing Cross, West End & City	5	5	5	3½ — 4¼	..	5 19 2
Do. 4½ % Cum. Pref.	5	4½	4½	4½ — 5	..	4 10 0
Do. "City Undertaking" 4½ % Cum. Pref.	5	4½	4½	3⅞ — 4¼	..	5 5 11
Do. Do. 4 % Deb.	100	4	4	94 — 98	..	4 1 8
Chelsea, Ord.	5	4½	5	4 — 4½	..	5 11 1
Do. 4½ % Deb.	Stock	4½	4½	98 — 100	..	4 10 0
City of London, Ord.	10	7	7	12 — 12½ xd	..	5 12 0
Do. 6 % Cum. Pref.	10	6	6	11¾ — 12¼ xd	..	4 14 1
Do. 5 % Deb.	Stock	5	5	119 —123	..	4 1 4
Do. 4½ % Second Deb.	100	4½	4½	100 —103	..	4 7 5
County of Durham, 5 % First Mort. Deb.	Stock	5	5	89½ — 91½	..	5 9 3
County of London, Ord.	10	5	5	7⅜ — 7⅞	..	6 7 0
Do. 6 % Pref.	10	6	6	10⅝ — 11⅜	— ⅛	5 5 6
Do. 4½ % Deb.	Stock	4½	4½	108 —110	..	4 1 10
Do. 4½ % Second Deb.	Stock	4½	4½	100 —103	..	4 7 5
Edmundson's, Ord.	5	Nil	Nil	⅛ — ¼	..	Nil
Do. 6 % Cum. Pref.	5	Nil	Nil	2 — 2½	— ⅛	Nil
Do. 4½ % First Mort. Deb.	100	4½	4½	83 — 86	..	5 4 8
Folkestone	5	5½	6	4½ — 5	..	6 0 0
Do. 5 % Cum. Pref.	5	5	5	4¾ — 5¼	..	4 15 3
Do. 4½ % First Deb.	100	4½	4½	95 — 98	..	4 11 10
Hove	5	8½	9	6⅞ — 7⅜	..	6 2 0
Kensington & Knightsbridge, Ord	5	8	9	6¾ — 7⅛	..	6 0 0
Do. 4 % Deb.	Stock	4	4	91 — 93	..	4 6 0
Kent Elec. Power, 4½ % Deb.	Stock	4½	4½	80 — 84	..	5 7 2
London Electric, Ord.	3	2	2	1⅝ — 2	..	3 0 0
Do. 6 % Pref.	5	6	6	4½ — 4⅞ xd	..	6 3 1
Do. 4 % First Mort. Deb.	Stock	4	4	89 — 92	..	4 7 0
Metropolitan	5	5	5	3¾ — 4¼	..	5 17 8
Do. 4½ % Cum. Pref.	5	4½	4½	4¼ — 4¾	..	4 14 9
Do. 4½ % First Mort. Deb.	Stock	4½	4½	100 —105	..	4 5 9
Do. 3½ % Mort. Deb.	Stock	3½	3½	84½ — 87½	..	4 0 0
Midland Electric Corporation 4½ % First Mort. Deb.	100	4½	4½	96½ — 98½	..	4 11 5
Newcastle-on-Tyne	5	4	4	3¾ — 4	..	5 0 0
Do. 5 % Pref., Non. Cum.	5	5	5	4 — 4½	..	5 11 1
North Metropolitan Power Supply, 5 % Mortgages (Red.)	100	5	5	101 — 104	..	4 16 2
Notting Hill	10	7½	8	..	..	..
Oxford	5	7	7½	6½ — 6⅞	..	5 9 5
St. James' and Pall Mall, Ord.	5	10	10	8¾ — 9¼	..	5 8 1
Do. 7 % Pref.	5	7	7	6¾ — 7¼	..	4 16 7
Do. 3½ % Deb.	100	3½	3½	85 — 87	..	4 0 6
Smithfield Markets, Ord.	5	Nil	Nil	1⅜ — 1⅝	..	Nil
South London, Ord.	4	5	5	2⅜ — 3	..	6 13 4
Do. 5 % First Mort. Deb.	100	5	5	98½ — 101½	..	4 18 6
South Metropolitan, 7 % Pref.	1	7	7	1 1/16 — 1 3/16 xd	— 1/32	5 17 11
Do. 4½ % First Deb. Stock	100	4½	4½	97 —100	..	4 10 0
Urban, Ord.	5	5	5	¾ — 1	..	..
Do. 5 % Cum. Pref.	5	5	5	2 — 2½	— ⅛	..
Do. 4½ % First Mort. Deb.	100	4½	4½	87½ — 89½	..	5 0 7
Westminster, Ord.	5	10	10	7½ — 8	..	6 5 0
Do. 4½ % Cum. Pref.	5	4½	4½	5 — 5⅜	..	4 3 9

COLONIAL AND FOREIGN ELECTRICITY SUPPLY AND POWER.

Adelaide, 6 % Pref.	5	6	6	5⅛ — 5⅜ xd	..	5 11 7
Calcutta, Ord.	5	8	8½	6⅜ — 7½	..	5 19 4
Do. 5 % Pref.	5	5	5	4⅜ — 5¼ xd	..	4 15 3
Calgary Power, 1st Mort. Bds.	100	5	5	96 — 98	..	5 2 0
Canadian Gen. El. Com.	$100	7	7	107 —112	—1	6 5 0
Do. 7 % Pref.	$100	7	7	121 —125	..	5 12 0
Cordoba Lt., Power and T., Ord.	1	2	3	3/32 — 5/32	..	3 8 4
Do. 5 % Deb.	100	5	5	94 — 97	..	5 3 1
Elec. Lt. and P. of Cochabamba, 6 % Bonds	100	..	6	94 — 96	..	6 5 0
Elec. Supply Victoria, 5 % 1st Mort. Deb.	100	5	5	84½ — 87½	..	5 14 3
Elec. Dev. Ontario, 5 % 1st Mort. Bonds	$500	5	5	85 — 87 xd	..	5 14 11
Kalgoorlie Elec. P. and L., Ord.	10/-	Nil	Nil	1/32 — 1/16	..	Nil
Do. 6 % Pref.	1	6	6	3/32 — 5/32	..	8 6 8
Kaministiquia Power, 5 % G. Bs.	$500	5	5	101½ — 103½	+ ½	4 16 7
Madras, Ord.	5	Nil	..	2⅜ — 3¼	..	..
Melbourne, 5 % 1st Mort. Deb.	100	5	5	95 — 97	..	5 3 1
Mexican El. Lt., 5 % 1st M. Bds.	..	5	5	88½ — 89½	— ¾	5 12 1
Mexican Lt. & Power, Common	$100	4	4	86 — 88	—1	4 10 11
Do. 7 % Cum. Pref.	$100	7	7	106 —108	—2	6 9 8
Do. 5 % 1st Mort. Gold Bds.	..	5	5	95 — 97	—1	5 3 1
Monterey Rly. Light & Power, 5 % 1st Mort. Deb.	100	5	5	88½ — 90½	— ½	5 10 6
Montreal, Lt., H. and Power	$100	6	7	165 —170	..	4 2 4
Northern, Lt., Power and Coal, 5 % 1st Mort. Bonds	$500	5	5	39 — 41	..	12 3 10
River Plate, Ord.	Stock	9	10	218 —228	..	4 7 9
Do. 6 % Non-Cum. Pref.	Do.	6	6	107 —114	..	5 5 3
Do. 5 % Deb. Stock	Do.	5	5	101½ — 103½	..	4 16 7
Roy. Elec. Co., Montreal, 4½ % 1st Mort. Deb.	100	4½	4½	100 —102	..	4 8 3
Shawinigan Water, Capital	$100	4	4	114 —116	..	3 0 9
Do. 5 % Con. 1st Mort. Bonds	$500	5	5	107 —109	..	4 11 9
Do. 4½ % Per. Deb.	Stock	4½	4½	103 —105	..	4 5 9
Toronto Power, 4½ % Deb.	Do.	4½	4½	99 —101	..	4 9 1
Vera Cruz Lt., P. and T., 5 % 1st Mort. Deb.	100	5	5	92 — 94	..	5 6 5
Victoria Falls Power, Pref.	1	Nil	Nil	3/32 — 5/32	..	..
West Kootenay Power and Lt., 1st Mort. 6 % Gold	100	..	6	105 —107 xd	..	5 12

TELEGRAPH AND TELEPHONE COMPANIES.

Amazon Telegraph	10	Nil	Nil	7⅜ — 7⅞	..	Nil.
Do. 5 % Deb. Red.	Stock	5	5	98½ — 100½	..	4 19 6
American Telep. & Teleg., Cap.	$100	8	8	136 —138	..	5 15 11
Do. Collat. Trust	$1000	4	4	94 — 96	..	4 3 4
Anglo-American Telegraph	Stock	3⅜	3⅜	67⅛ — 69½	..	5 7 11
Do. 6 % Pref.	Do.	6	6	111½ — 112⅜	..	5 6 5
Do. Def.	Do.	25/-	30/-	24⅜ — 25	— ⅛	6 0 0
Anglo-Portuguese Tel., 5 % Mort. Deb.	100	5	5	100 —102 xd	+1	4 18 0
Chili Telephone	5	8	7	6 13/32 — 7 3/32	..	4 18 3
Commercial Cable, Stlg. 4 % Deb.	Stock	4	4	87¼ — 89½	..	4 9 5
Cuba Telegraph	10	6	6	10¾ — 11	..	5 9 1
Do. 10 % Pref.	10	10	10	17¾ — 18½	..	5 9 7
Direct Spanish Telegraph, Ord.	5	4	4	3¾ — 4	..	5 0 0
Do. 10 % Cum. Pref.	5	10	10	8¾ — 8¾	..	5 14 3
Do. 4½ % Debs.	50	4½	4½	100 —102	..	4 8 3
Direct United States Cable	10	4½	4½	7⅜ — 8¼	— ⅛	5 9 1
Direct W. India Cable, 4½ % Reg. Deb.	100	4½	4½	99 —101	..	4 9 1
Eastern Telegraph, Ord. Stock	Stock	7	7	137 —140	+1	5 0 0
Do. 3½ % Pref. Stock	Do.	3½	3½	84 — 86	..	4 1 5
Do. 4 % Mort. Deb.	Do.	4	4	102 —104	..	3 16 11
Eastern Extension	10	7	7	13⅜ — 14½	+ ⅛	4 19 1
Do. 4 % Deb.	Stock	4	4	100½ — 102½	..	3 18 1
East and S. Africa Tel. 4 % Mt. Db. Mauritius Sub.	25	4	4	100 —102	..	3 18 5
Globe Telegraph and Trust	10	5/6	5/6	10⅜ — 11⅛	— ⅛	5 5 7
Do. 6 % Pref.	10	6	6	13 — 13½	..	4 8 11
Great Northern Telegraph	10	18	18	31 — 32	..	5 12 6
Indo-European Telegraph	25	13	13	56½ — 58½	..	5 11 1
Mackay Companies Common	$100	4	5	86 — 88	..	5 13 8
Do. 4 % Cum. Pref.	$100	4	4	76 — 78	..	5 2 7
Marconi's Wireless Telegraph	1	Nil	Nil	2¼ — 2⅜	— 1/16	..
Monte Video Telephone, Ord.	1	6	6	7/16 — 1/2	..	6 0 0
Do. 5 % Pref.	1	5	5	1/2 — 5/8	..	5 10 4
National Telephone, Pref.	Stock	6	6	104 —106	..	5 18 2
Do. Def.	Do.	6	6	117 —120	— ½	5 0 0
Do. 6 % Cum. 1st Pref.	10	6	6	10 — 10⅜	..	5 11 7
Do. 6 % Cum. 2nd Pref.	10	6	6	10 — 10⅜	..	5 11 7
Do. 5 % Non-cum. 3rd Pref.	5	5	5	5 5/16 — 5 7/16	— 1/16	4 9 11
Do. 3½ % Deb.	Stock	3½	3½	98½ — 100½	..	3 9 8
Do. 4 % Deb.	Do	4	4	98½ — 100½	..	3 19 7
New York Telep., 4½ % Gen. Bnds.	100	4½	4½	102½ — 103½	..	4 7 0
Oriental Telep. and Elec.	1	8	8	1 3/16 — 1 5/16	..	4 8 8
Do. 6 % Cum. Pref.	1	6	6	1 3/16 — 1 5/16	..	4 11 5
Do. 4 % Red. Deb.	Stock	4	4	88 — 90	..	4 8 11
Pacific and European Tel., 4 % Guar. Debs.	Do.	4	4	99½ — 101½	..	3 18 10
Reuter's	8	5	5	8⅝ — 9¼	..	4 7 9
Submarine Cables Trust	Cert.	6	6	132 —135	..	4 8 11
Telephone Co. of Egypt, 4½ % Deb. Red.	Stock	4½	4½	99 —101	..	4 9 1
United River Plate Telephone	5	8	8	7¼ — 7½	..	5 6 8
Do. 5 % Cum. Pref.	5	5	5	5¼ — 5½	..	4 10 11
West Coast of America	2½	2½	2½	1⅝ — 1⅞	..	6 5 0
Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4	4	98 —100	..	4 0 0
West India and Panama Teleg.	10	Nil	¾	2⅛ — 2⅜	— 1/16	2 14 7
Do. 6 % Cum. 1st Pref.	10	6	6	10⅛ — 10⅝	..	5 12 11
Do. 6 % Cum. 2nd Pref.	10	14½	6	9⅞ — 10¼	..	5 17 1
Do. 5 % Debs.	100	5	5	101 —103	..	4 17 1
Western Telegraph, Ltd.	10	7	7	13½ — 14	..	5 0 0
Do. 4 % Deb.	Stock	4	4	101 —103	..	3 17 8
Western Union Tel., 4 % Bnds. A	$1000	4	4	107 —110	..	3 12 9
Do. 4½ % Fdg. Bonds	$1000	4½	4½	101 —104	..	4 6 7

* Unless otherwise stated, all shares are fully paid.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRIC RAILWAYS AND TRAMWAYS.—HOME.

NAME.	Stock or Share.	Dividends for 1909.	Dividends for 1910.	Closing Quotations Sept. 5th.	Rise + or Fall —	Present Yield p.c.
	*					£ s. d.
Bath Trams, Pref. Ord.	1	Nil	Nil	1/10 — 1/4	— 1/16	Nil
Do. 5 % Pref.	1	5	5	1/2 — 3/4	..	6 13 4
Do. 4½ % Deb.	100	4½	4½	79 — 83	..	5 8 5
Brit. Elec. Trac., Ord.	10	Nil	Nil	3/8 — 1½	..	Nil
Do. 6 % Pref.	10	1½	1½	9⅜ — 9⅝	— ⅛	3 17 5
Do. 5 % Deb.	100	5	5	93 — 96	—1	5 4 2
Do. 4½ % 2nd Deb.	100	4½	4½	75 — 79	..	5 13 11
Central London Railway, Ord.	100	8	8	67 — 69	..	4 6 11
Do. Pref.	100	4	4	85 — 87	..	4 12 0
Do. Def.	100	2	2	49 — 51	..	3 18 5
Do. 4 % Deb.	100	4	4	102 —104	..	3 16 11
City & South London, Ord.	100	1½	1½	29 —30	— ½	5 0 0
Do. 5 % Pref., 1891	100	5	5	108 —110	..	4 11 0
Do. Do. 1896	100	5	5	104 —106	..	4 14 4
Do. Do. 1901	100	5	5	103 —105	..	4 15 3
Do. Do. 1903	100	5	5	102 —104	..	4 16 2
Do. 4 % Deb.	100	4	4	102 —104	..	3 16 7
Dublin United Trams, 6 % Pref.	10	6	6	11½ — 12½	— ½	4 16 0
Great Northern & City, Pr'f. Ord	10	Nil	Nil	1/8 — 1½	..	Nil
Hastings Trams, 6 % Pref.	5	Nil	Nil	..	..	Nil
Do. 4½ % Deb.	100	4½	4½	75 — 80	..	5 12 6
Isle of Thanet Trams, 5 % Pref.	5	1½	2½	2½ — 3	..	4 3 4
Do. 4 % Deb.	100	4	4	77 — 82	..	4 17 7
Lancashire United, 5 % Deb.	100	5	5	79 — 82	..	6 1 11
London Elec. Railw'ys, 4 % Deb.	100	4	4	96 — 98	..	4 1 8
London United Trams, 5 % Pref.	10	Nil	Nil	3½ — 3⅝	..	Nil
Do. 4 % Deb.	100	4	4	70 — 75	..	5 6 8

NAME.	Stock or Share.	Dividends for 1909.	Dividends for 1910.	Closing Quotations Sept. 5th.	Rise + or Fall —	Present Yield p.c.
	*					£ s. d.
Metropolitan Railway Consol.	100	1	1⅜	43 — 43½	—1⅛	3 3 3
Do. Surplus Lands	100	2⅜	2⅝	64 — 66	—1	4 3 4
Do. 3½ % Deb.	100	3½	3½	92 — 4	..	3 14 6
Do. 3½ % Pref.	100	3½	3½	88 — 90	..	3 17 9
Do. 3½ % Con. Pref.	100	3⅝	3⅝	87 — 89	..	3 18 8
Metropolitan District Ord.	100	Nil	Nil	23⅜ — 24¼	—1	Nil
Do. 6 % Deb.	100	6	6	145 —147	..	4 1 8
Do. 4 % Deb.	100	4	4	96 — 98	..	4 1 8
Do. 4 % Prior Lien	100	4	4	100 —102	..	3 18 5
Do. 4½ % First Pref.	100	Nil	3½	86 — 88	..	3 13 10
Do. 3½ % Gtd.	100	3½	3½	74 — 76	..	4 9 9
Metropolitan Elec. Trams, Ord.	1	5	5½	1/32 — 1 1/32	..	5 6 8
Do. Def.	1	Nil	Nil	1/32 — 1/16	..	Nil
Do. 5 % Pref.	1	5	5	1/8 — 1	..	5 0 0
Do. 4½ % Deb.	100	4½	4½	99 —101	..	4 9 1
Do. 5 % Deb.	100	5	5	102 —104	— ½	4 16 2
Potteries, Ord.	1	2	2	7/32 — 9/32	..	..
Do. 5 % Pref.	1	5	5	3/32 — 5/32 xd	..	7 12 4
Do. 4½ % Deb.	100	4½	4½	88 — 91	..	5 18 11
South Metro. Trams, 6 % Pref.	1	3	6	1/8 — 1/8	..	10 3 0
Do. 4 % Deb.	100	4	4	73 — 78	..	5 15 5
Underground Elec. Railways 5 % Prior Lien	..	5	5	100½—101½	..	4 18 6
Do. 4½ % Bonds	100	4½	4½	98 —100	..	4 10 0
Do. 6 % Income	100	Nil	1	£9 — 61	—1	1 12 9
Do. Power House Debs.	100	..	4	101 —103	..	3 17 8
Yorkshire (West Riding), Ord.	5	Nil	Nil	1/8 — 3/16	..	Nil
Do. 6 % Pref.	5	Nil	Nil	2⅜ — 2⅞	..	Nil
Do. 4½ % Deb.	100	4½	4½	80 — 85	..	5 5 11

ELECTRICAL RAILWAYS AND TRAMWAYS.—COLONIAL AND FOREIGN.

Anglo-Arg. Trams, 1st Pref.	5	5	5	5⅛ — 5⅝	..	5 3 6
Do. 2nd Pref.	5	5	5	4⅞ — 5	..	5 0 0
Do. 4 % Deb.	100	4	4	94 — 96	..	4 3 4
Do. 4½ % Deb.	100	4½	4½	101 —103	..	4 7 5
Do. 5 % Deb.	100	5	5	101 —103	+ ½	4 17 1
Auckland Trams, 5 % Deb.	100	5	5	102 —105	..	4 16 2
Bombay Elec. S. & Trams, Pref.	10	6	6	10⅜ — 11⅛	..	5 6 8
Do. 4½ % Deb.	100	4½	4½	96⅞ — 98⅜	..	4 11 5
Do. 5 % 2nd Deb.	100	5	5	97 — 99	..	5 1 0
Brisbane Trams Invt., Ord.	5	8	8	6⅝ — 7⅛	..	5 12 3
Do. 5 % Pref.	5	5	5	5 — 5⅛	..	4 13 0
Do. 4½ % Deb.	100	4½	4½	102 —105	..	4 5 9
B. Columbia Elec. Rly., Def.	100	8	8	137 —141	—2	5 13 6
Do. Pref. Ord.	100	6	6	119 —123	..	4 17 7
Do. 5 % Pref.	100	5	5	106 —109	..	4 11 9
Do. 4½ % 1st Mort. Deb.	40	4½	4½	100 —103	..	4 7 5
Do. 4½ % Vancouver Deb.	100	4½	4½	101 —104	..	4 6 7
Do. 4½ % Con. Deb.	100	4½	4½	103 —105	..	4 5 9
Calcutta Trams, Ord.	5	4½	6	5⅝ — 6¼	..	4 16 0
Do. 5 % Pref.	5	5	5	5 — 5⅛	..	4 15 3
Do. 4½ % Deb.	100	4½	4½	102 —105	..	4 5 9
Cape Electric Trams	1	Nil	Nil	1/16 — 1/8	..	Nil
City Buenos Aires Trams (1904)	5	5	5	5⅜ — 5⅝	..	4 12 6
Do. 4 % Deb.	100	5	5	95 — 98	+1	5 2 0
Colombo Elec. Tr. & Lt., 6 % Deb.	100	5	5	95 —100	..	5 0 0
Havana Elec. Rly., 5 % Bonds	$1000	5	5	100 —103	..	4 17 1
Kalgoorlie Elec. Trams	1	Nil	Nil	3/16 — 5/16	..	Nil
Do. 5 % A Deb.	100	5	5	92½ — 95½	..	5 4 9
Do. 6 % B Deb.	100	6	5	63 — 67	..	7 9 3

La Plata Elec. Trms, Prf.	1	6	6	1/16 — 1 1/16	..	5 13 0
Lisbon Elec. Trams, Ord.	1	5½	5½	1 — 1⅛	..	4 8 0
Do. 6 % Pref.	1	6	6	1 — 1⅛	..	4 16 0
Do. 5 % Deb.	100	5	5	97 —101	..	4 19 0
Madras Elec. Tr. (1904), Deb.	100	5	5	95 — 98	..	5 2 0
Manaos Trams & Lt., 1st Deb.	100	..	5	88 — 91	..	5 9
Manila Elec. R. and Ltg., Bonds	$1000	5	5	97⅛ — 99½	..	5 0 6
Mexico Trams Com.	$100	7	7	116 —118	—8	5 18 8
Do. Gen. Con. 5 % Bonds	..	..	5	97 — 98 xd	..	5 2 0
Do. 6 % Bonds	100	6	6	98½—100½	..	6 16 8
Para Elec. Rlys. & Lt., Ord.	5	..	10	6⅞ — 7⅛ xd	..	6 17 11
Do. 6 % Pref.	5	6	6	5⅝ — 5⅞ xd	..	5 6 8
Do. 5 % 1st Deb.	100	5	5	99⅜—101⅜	..	4 18 6
Perth (W.A.) Elec. Tr., Ord.	1	2½	2½	1/16 — 1 1/32 xd	+ 5/32	2 7 1
Do. 5 % 1st. Deb.	100	5	5	101½—103½	..	4 16 7
Rangoon El. Tr. & Sup., Pref.	5	6	6	5⅛ — 5⅜	..	5 6 8
Do. 4½ % 1st Deb.	100	4½	4½	98 —101	..	4 9 1
Rio de Janeiro Trams	$100	1	4½	114⅜—115⅝	— ⅜	3 17 9
Do. 1st Mort. 5 % Bonds	..	5	5	101½—102½	..	4 17 16
Do. 5 % Mort. Bonds	100	5	5	98 — 99	+ ¼	5 1 0
Sao Paulo Tram, Lt. and P.	$100	10	10	177 —180	—1	5 11 1
Do. 5 % 1st Deb.	$500	5	5	102½—104½	— ½	4 15 8
Singapore Trams, 5 % Deb.	100	5	5	83 — 87	..	5 15 0
Southern El. Tr. B.A., 5 % Deb.	100	5	5	95 — 98	..	5 2 0
Un. Elec. Trams Monte Video	5	5	6	5½ — 6	..	5 0 0
Do. 6 % Pref.	5	6	6	5 — 5½	..	5 9 1
Do. 5 % 1st Deb.	100	5	5	102 —105	..	4 15 3
Winnipeg Elec. Rly., 4½ % Deb.	100	4½	4½	107 —109	..	4 2 7

MANUFACTURING COMPANIES.

Aron, Ord.	1	..	Nil	5/8 — 3/4	..	Nil
Do. 6 % Pref.	1	12	9	11/16 — 13/16	..	7 7 8
Babcock & Wilcox	1	24	26	5⅜ — 5⅝	..	4 12 6
Do. Pref.	1	6	6	1⅜ — 1½	..	4 0 0
B.I. & Helsby Cables	5	10	10	6⅝ — 7⅝	..	6 15 7
Do. Pref.	5	6	6	5½ — 6¼	..	4 16 0
Do. Deb.	100	4½	4½	102 —104	..	4 6 7
British Thomson-Houston, Deb.	100	4½	4½	94 — 97 xd	..	4 12 9
British Westinghouse, Pref.	3	Nil	Nil	1/4 — 3/8	..	Nil
Do. Deb.	100	4	4	59 — 62	..	6 9 1
Do. 6 % Prior Lien	100	6	6	102 —104	..	5 15 5
Browett, Lindley, Ord.	1	Nil	Nil	1/6—2/-	..	Nil
Do. Pref.	1	Nil	Nil	5/- —6/-	..	Nil
Brush, Ord.	2	Nil	Nil	1/16 — 1/8	..	Nil
Do. 7 % Pref.	2	Nil	Nil	1/8 — 3/16	..	Nil
Do. 4½ % Deb.	100	4½	4½	56 — 61 xd	..	7 7 7
Do. 4½ % Second Deb.	100	4½	4½	39 — 44	..	10 4 6
Callender's Cable	5	15	15	9½ — 9⅝	..	7 15 11
Do. Pref.	5	5	5	4⅛ — 5⅛	..	4 16 5
Do. Deb.	100	4½	4½	101 —103	..	4 7 5
Castner-Kellner	1	14	17½	3⅜ — 3⅝	..	4 17 0
Do. Deb.	100	4½	4½	102 —105	..	4 5 9
Crompton & Co.	3	Nil	Nil	3/8 — 3/8	..	Nil
Do. Deb.	100	5	5	57½ — 67½	..	7 8 2

Dick, Kerr	1	6	5	13/16 — 15/16	..	5 6 8
Do. Pref.	1	6	6	1 3/16 — 1 5/16	..	5 9 7
Do. Deb.	100	4½	4½	95 — 98	..	4 11 10
Edison & Swan, A, £3 paid	5	Nil	Nil	2 — 2⅛	..	Nil
Do. fully paid	5	Nil	Nil	1⅝ — 2⅜	..	Nil
Do. 4 % Deb.	100	4	4	67 — 71	..	5 12 8
Do. 5 % Second Deb.	100	5	5	78 — 81	..	6 3 5
Electric Construction	2	Nil	2½	2⅜ — 2⅝	..	6 8 0
Do. Pref.	2	7	7	1 1/16 — 1 1/8	..	7 4 4
Greenwood & Batley, Pref.	10	7	7	7⅞ — 8¼	..	8 5 8
Do. Deb.	100	5	5	94 — 96	..	5 4 2
General Electric, Pref.	10	5	5	8¾ — 9	..	5 11 1
Do. Deb.	100	4	4	88 — 98	..	4 6 0
Henley's, Ord.	5	15	15	12 — 12⅜ xd	+ ⅛	5 17 8
Do. Pref.	5	4½	4½	4⅛ — 5⅛ xd	+ 1/16	4 5 11
Do. Deb.	100	4½	4½	106⅜—108½	..	4 2 11
India-Rubber, G. & T.	10	10	10	13 — 15	..	6 13 4
Do. Pref.	10	5	5	9⅞ — 10⅜	..	4 16 5
Telegraph Construction	12	17½	20	34½ — 36½	..	6 11 7
Do. Deb.	100	4	4	100 —102	..	3 18 5
Willans & Robinson	1	Nil	Nil	3/32 — 5/32	..	Nil
Do. Pref.	5	1½	Nil	0 — 1	..	Nil
Do. Deb.	100	4	4	55 — 65	..	6 3 1

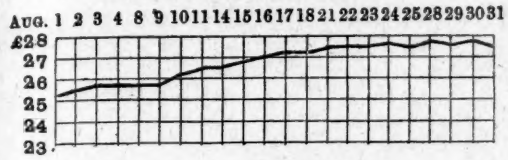
* Unless otherwise stated, all shares are fully paid.

Bank rate of Discount 3 per cent., March 9th, 1911.

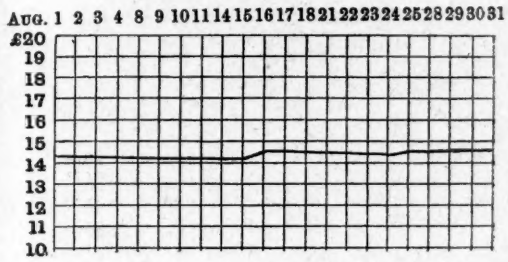
METAL MARKET.

Fluctuations in August.

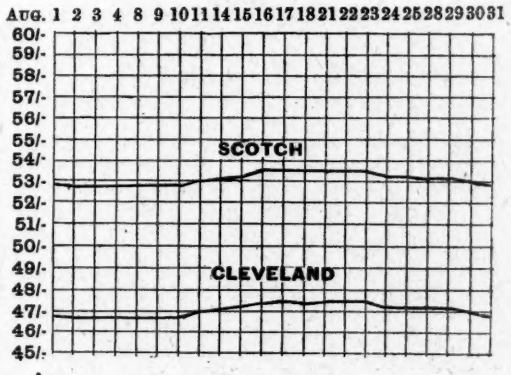
SPELTER (G.O.B's.).



LEAD (ENGLISH).



IRON.



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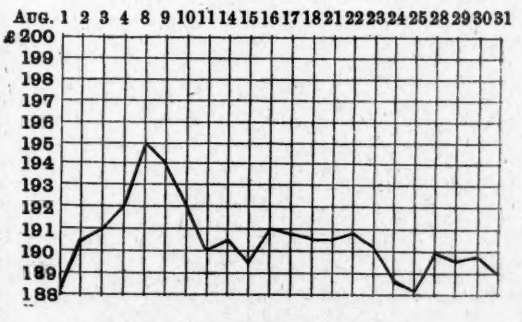
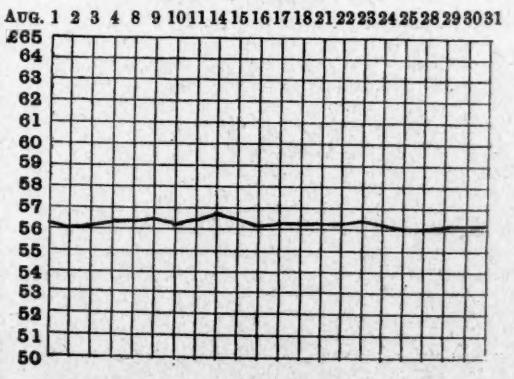


COPPER (G.M.B's.).



A REVOLUTIONARY SUGGESTION.

[COMMUNICATED.]

It should be, and is, a general rule in business concerns to promote existing employés when vacancies occur, in place of bringing in new men from outside. This question of promotion requires very careful consideration, the more so as the person who is called upon to make the choice only knows the capabilities of his subordinates to a limited extent, and is apt to select the man who shows off his wares to the best advantage.

It is only a man's *confrères* who are working with him, or perhaps under him, who know his qualifications thoroughly, and, such being the case, it would appear advisable that this knowledge should be extracted and made use of.

It is, of course, impossible to consult the prospective subordinates individually as to the fitness of one of their number to be placed over them, but there is no reason why they should not be asked to give their collective opinion through the medium of the ballot box.

Where it is a question of choosing from several candidates, this system should offer no considerable difficulties, and even when promotion must necessarily refer to one particular man, his existing subordinates might be consulted with advantage as to whether he shall have the vacant post or a new man shall be obtained from outside.

It may be contended that the elective system would result in the appointment of men possessed of easy-going notions regarding work and discipline. There is no evidence, however, to show that such would be the case. A "slacker" is not usually popular with his subordinates for several reasons, amongst which may be mentioned the bad reputation he brings down on his department, and his inequitable treatment of those under him, the strong being leniently dealt with, whilst undue severity is meted out to the weak. Then, again, a man of this description does not properly protect the interests of his assistants, and, in case of blame being unfairly attached to one of them, he cannot be depended upon for a strong and effective defence.

For these reasons, which are now well understood by both office staffs and workmen, great care would be taken to select the best man for promotion where an election was resorted to, and it is probable that better men would be chosen than by the manager or directors from their necessarily limited knowledge.

The best men, when placed in charge of others, are always popular with their subordinates, and, if good results are to be obtained, it is essential that responsible posts should be filled by those who find favour with their office assistants or the workmen under them. The days are past when men could be driven, if, indeed, they ever existed in connection with skilled labour. Men must be interested in their work by some means or other, and the influence of a popular foreman or head of a department makes a great deal of difference.

In this connection two recent strikes are of particular interest. In one case the men turned out owing to the appointment of an unpopular official, who had to be removed before an agreement could be arrived at. In the other, a strike was quickly brought to an end by the influence of the works manager, who was deservedly popular with both the men and the directors.

The elective system of promotion would at least ensure the appointment of men approved by those who work under them, and a desire to promote the success of their selection would be engendered in the electors, who would consequently put forth their best efforts in this direction.

It is also more than probable that promotion by election would lead to greater interest in their work by all concerned, and it should have a salutary effect upon the few grumblers who cause trouble in every establishment.

The Proposed Aluminium Syndicate.—According to a Berlin communication to a Frankfort newspaper, the negotiations which have been proceeding for some time past with the object of re-establishing the International Aluminium Syndicate, can now be regarded, as was reported at a recent board meeting of the Neuhausen Aluminium Industry Co., as having entirely miscarried. Whilst it was formerly said that the demands of the Neuhausen Co. stood in the way of an agreement in connection with the efforts to form a convention, the resistance of the British Aluminium Co. is now held to be the reason for the failure of the negotiations. The Swiss company is declared, in the opinion of the directors, to have gone to the extreme in endeavouring to meet the case, as it was prepared to accept an allotment which would only have corresponded with 50 per cent. of the productive capacity of the works. As there is now no prospect of an understanding between the principal European producers being reached for some time, the Neuhausen Co. proposes to proceed with the scheme for the raising of fresh capital, which was postponed a little time ago, in view of a possible resuscitation of the International syndicate. It is intended to make an issue through a Swiss syndicate, headed by the Swiss Credit Anstalt and the Swiss Bank Verein, of £240,000 in 4½ per cent. bonds, the proceeds being devoted to defraying the cost of erecting new plants and extinguishing the bank debt. The company already has a loan which was raised to the amount of £240,000 in 1897 and 1899, but which had been reduced to £206,000 by the end of 1910.

ELECTRICITY SUPPLY AND EXHAUST STEAM HEATING.

By FRANCIS H. DAVIES.

The subject of steam heating from central stations has received very little, if any, attention in this country, despite the fact that there are some 400 plants operating on such lines in America. Of these, some were installed specially for the purpose, and employ live steam. Others utilise the exhaust steam from industrial plants, and a large number are operated in connection with electricity supply undertakings. Heating by low-pressure steam through the medium of radiators is well known to be a very popular system in America, and one which particularly suits both the climatic conditions and the prevailing ideas of comfort. On the other hand, British conservatism and preference for the open fire have militated against the introduction of the system to this country, although there can be no question that it is gaining ground, especially in office blocks, flats, public buildings and factories, for which situations it possesses many admirable features.

This being the case, the question arises whether it might not, in certain instances, pay central station engineers to investigate the possibilities which have so readily been taken advantage of in America. Conditions are, in the main, different. The British climate is erratic, and even in winter the demand for heat is by no means uniform. Still, under favourable circumstances, such as would obtain in the case of an electricity works centrally situated in a small and good class area, it seems quite possible that a well designed scheme might prove a highly remunerative investment. With few exceptions this has been found to be the case in America, where the combination of an electricity works and an exhaust steam heating installation is considered the best possible arrangement from the economic point of view. Fortunately, there is available a certain amount of data concerning the results attained by such plants, and Table I in the adjoining column summarises the working particulars of four combined undertakings instanced by Mr. C. R. Bishop in a paper read before the National Electric Light Association.

TABLE I.—Results of Combined Electric Power and Steam Heating Stations.

	Plant No. 1.	*Plant No.* 2.	*Plant No.* 3.	*Plant No.* 4.
Annual electrical output, units	1,902,970	541,767	1,081,150	2,498,508
Coal used, lb.	16,383,649	6,768,661	14,448,399	24,837,136
Water used, all purposes, lb.	145,302,510	48,131,094	86,296,235	177,053,950
Coal cost	£4,330	£1,637	£4,703	£3,187
Water cost	£142	£95		£220
Oil and waste	£122	—	£116	£76
Boiler room labour	£507	£211	£473	£910
Engine room labour	£412	—	£261	£488
Dep. and int. on capital cost of heating installation at 10 %	£2,506	£924	£924	£2,114
Total cost	£8,019	£2,867	£6,477	£6,995
Revenue from sale of steam	£7,636	£2,566	£7,197	£5,324
Capital cost of heat installation	£25,065	£9,240	£9,240	£21,149
Average price received per 1,000 lb. of steam	1s. 8d.	1s. 8d.	2s. 6d.	1s. 1½d.
Approximate space heated, cb. ft.	10,000,000	—	7,976,976	16,000,000
Heating season	Oct. 1/08 to May 25/09.	Oct. 1/07 to May 1/08.	Oct. 1/08 to June 1/09.	Oct. 1/08 to June 1/09.
Population of town	17,500	10,000	10,000	43,000
Age of combined undertaking	3 years	5 years	8 years	—

In Table II some interesting particulars are given of the operation of the combined electric light and exhaust steam heating plant installed at West Chester, Pa., a city of some 10,000 inhabitants. There are over 200 heat consumers, and the service was inaugurated in 1902. Approximately 100,000 sq. ft. of radiating surface is connected, and there are about 8,900 ft. of underground steam main, supplied at

TABLE II.—Table Showing Results of Operating West Chester Central Station Heating Plant for 12 Months.

Month.	Lb. of coal burned.	Cost of coal. £	Total lb. of water evaporated.	Cost of water. £	Lb. of water evaporated per lb. of coal.	Electric output, kw.-hours.	Lb. of water per kw.-hour.	Lb. of steam sold for heat.	Steam not sold for heating. Total.	Steam not sold for heating. Per kw.-hour.	Income from steam sold for heat. £	Cost of boiler house labour. £	Total cost of coal, water, and boiler house labour. £
July, 1907	476,885	110·56	3,646,433	7·18	7·66	58,440	62·4	—	3,646,433	62·4	—	30·18	147·92
Aug., 1907	516,325	111·27	3,046,065	6·01	5·90	63,994	47·6	—	3,046,065	47·6	—	30·18	147·46
Sept., 1907	540,094	113·42	3,897,980	7·67	7·20	69,680	55·9	—	3,897,980	55·9	—	30·18	151·25
Total non-heating months	1,533,304	335·25	10,590,478	20·86	6·91	192,114	55·1	—	10,590,478	55·1	—	90·54	446·63
Oct., 1907	756,866	161·41	5,451,120	10·75	7·20	76,739	71·0	2,280,000	3,171,412	41·40	187·72	30·18	202·34
Nov., 1907	885,570	176·27	6,053,119	12·01	6·84	72,520	84·6	3,640,000	2,413,119	33·75	299·11	30·18	218·46
Dec., 1907	1,157,940	255·34	7,322,804	14·43	6·34	82,365	89·0	5,340,000	1,992,804	24·24	437·93	30·18	299·95
Jan., 1908	1,180,005	312·59	8,207,054	16·16	6·96	87,620	93·8	5,780,000	2,427,054	27·72	474·56	30·18	358·93
Feb., 1908	1,233,560	327·92	8,694,744	17·14	7·04	79,430	109·0	6,540,000	2,154,744	27·17	537·53	30·18	375·24
Mar., 1908	886,240	235·59	7,091,419	14·18	8·01	78,070	90·8	4,710,000	2,381,419	30·58	387·05	30·18	279·95
Apr., 1908	668,460	168·33	5,310,542	10·47	7·95	66,023	80·4	2,950,000	2,360,542	35·80	242·36	30·18	208·98
May, 1908	509,167	128·21	5,302,341	10·45	10·40	65,248	81·2	1,258,000	4,044,341	62·00	103·42	30·18	168·84
June, 1908	487,053	109·81	3,820,806	7·53	7·86	58,164	65·7	635,000	3,185,806	54·80	52·24	30·18	147·52
Total heating months	7,764,861	1,875·48	57,254,241	113·12	7·37	665,179	86·1	33,123,000	24,131,241	36·27	2,721·92	271·62	2,260·21
Total 12 months	9,298,165	2,210·73	67,844,719	133·98	7·30	857,293	72·9	33,123,000	24,131,241	—	2,721·92	362·16	2,706·84

It will be noticed that after allowing 10 per cent. to cover depreciation and interest on the capital cost of the heating installation, the revenue from the sale of exhaust steam in three out of the four cases comes within a few hundred pounds of wiping out coal, water, oil and labour costs, while, in the fourth instance (plant No. 3), the receipts from steam exceed the above costs and the 10 per cent. allowance for depreciation and interest by £720. The capital cost of the heating installation is inclusive of street mains, services, trenching, repaving, street traps and meters.

The small population of the towns producing such excellent results is very noticeable, and this fact alone emphasises the wide difference between British and American conditions. The greatest optimist would not hope for even the most moderate success in English towns of from 10,000 to 17,000 inhabitants, and for the present, at any rate, the future for central station steam heating lies only in populous districts.

a pressure not exceeding 5 lb. per sq. in. in the coldest weather. This gives 1½ lb. per sq. in. at the extreme points of the system, a pressure which yields satisfactory results. The power house has 830 kw. of plant installed. With regard to Table II, it will be seen that during the non-heating months each unit generated required 55·1 lb. of water, while during the remaining portion of the year,

when a heating load was carried, the corresponding evaporation figure was 86·1 lb. of water. The increase is due in part to the admission of a percentage of live steam to the mains when the heating load exceeded the electrical load, and also to the increased steam consumption of the engines when running under back pressure. However, it should be noted that during the heating months about 33,123,000 lb. of water out of the 57,254,241 lb. evaporated were sold for heating purposes, leaving 24,131,241 lb. of water chargeable to the cost of electric generation and line losses in the heating mains. During these months 665,179 units were generated, and dividing this into the 24,131,241 lb. of water, the result is 36·27 lb. of water chargeable to each unit generated during the heating months, as against 55·1 lb. chargeable in the non-heating months.

As regards the financial results, it will be seen that the income from the sale of steam more than covered the total cost of coal, water and boiler-house labour. The running conditions of this station were not favourable to steam heating, since the electrical load was almost entirely lighting. This necessitated the addition of live steam to the heating mains during certain hours of the day, while at other times the amount of exhaust steam available was more than enough, and had partly to be thrown away to the atmosphere.

Fig. 1 shows graphically the results of 26 months' working

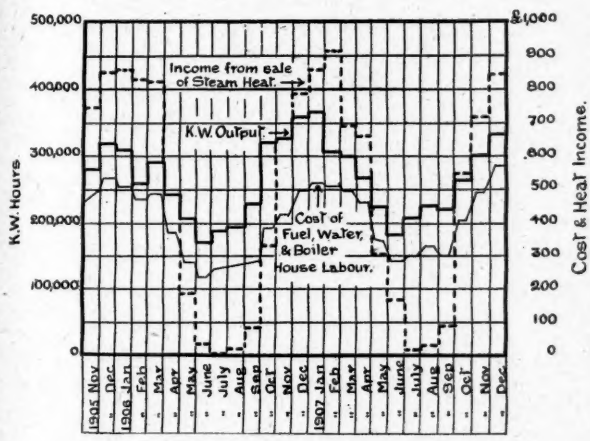


FIG. 1.

at the Vine Street station of Johnstown, Pa. This is a more extensive system than the previous one, as there are 13,340 ft. of underground steam main and 294 consumers, whose premises aggregate to 15,458,028 cb. ft. of space heated. The power station contains five engines with a total of 1,800 I.H.P., and during the period in question 6,856,950 units were generated, of which 5,252,347 were produced during the heating months. For the 26 months the total cost of fuel, water and boiler house labour amounted to £10,706, of which £8,413 was incurred during the 18 months. As against this, the income from the sale of steam alone was £12,928 over the whole period, and £12,468 during the heating months only. Thus the receipts from steam paid for all fuel, water and boiler house labour, and taking into account the 18 heating months alone, left a surplus of £4,055. Concurrently with earning this surplus, 5,252,347 units were generated from the same fuel, water and boiler-house labour.

These results are very good, and remarkable in that the rates charged for steam heat are stated to be the lowest on record. Mr. James A. White, who communicated the figures to the "Central Station" in May, 1908, makes the following significant comments:—"The results obtained from this combination plant are such that the seeming advantage of power house sites placed away from the thickly built-up sections of our towns and cities for the sake of cheap land, condensing water, or facility in the handling of coal entirely disappear, as does also the advantage of the gas engine, with its much vaunted thermal efficiency, and engineers in designing plants should look carefully into the advantages of such combination systems before making expenditure for power installations in locations where such a distribution of the unused heat cannot be made."

In considering the question in the light of any particular set of conditions, it is important to take into account the age and quality of the steam plant installed. The equipment of numerous stations in this country is out of date and inefficient, and ultimately the question will arise of replacing it by more modern plant. This is the usual way; but it has been found in America that having regard to the excellent revenue to be obtained from a steam heating load, it is less expensive, and productive of greater profit, to retain the old plant, and to spend the sum it would cost to replace it upon an underground exhaust steam distributing system. The capital required would probably be less, and the combined profit derived from the electric and steam undertakings would be greater than that which would accrue from even the most modern electric plant working without a heating system. This is the view taken by authorities who have studied the subject at close quarters, and it opens out a very interesting branch of the question.

Before deciding whether or no a steam-heating scheme is a feasible proposition, and before entering into details of the equipment, it is necessary to investigate local conditions very closely, and to ascertain how far they are in conformity with certain essentials. For instance, the generating station must be within a comparatively short distance of the area it is proposed to serve, in order that capital expenditure and loss in transmission may be kept within reasonable bounds. This brings into prominence the question of the class of property which would be most likely to take a supply, and here it becomes necessary to ignore the American precedent altogether, and to reason the matter out on our own lines. There can be little doubt that the private householder would not at the commencement look favourably upon the proposition. Doubtless a few would be secured, and ultimately good business might be done in residential property, but at the start the most likely customers would be those who are already employing steam or hot-water heating, and generally the classes to which they belong. As before stated, these include flats, office blocks, public buildings, factories, churches, theatres and other similar places. Hundreds of such are now operating their own heating plant, and given a moderate rate of supply it should not be difficult to secure their connection to the mains. The convenience of an outside supply is obvious, and the arguments put forward would, on the whole, be similar to those advanced in the case of a private generating plant. Modern ideas of comfort and health now make some sort of heating installation imperative in such buildings, and it would therefore not be too optimistic to anticipate a fair amount of business among new erections. Experience has also shown that where there is a public low-pressure steam supply, it is taken advantage of for other purposes than the heating of buildings; thus hotels and flats employ it in connection with their hot water supply, and laundries are also possible consumers.

The end at which preliminary operations must aim is to secure at least enough business to utilise, at the time of minimum demand for heat, the whole of the exhaust steam from any one engine. To render this possible, it is necessary so to arrange the station exhaust piping that any single engine can be run either condensing, non-condensing, or connected to the heating mains, and under back pressure. The average back pressure that is carried appears to be about 5 lb. per sq. in., but in cases it is higher, and has even attained 35 lb., with a boiler pressure of 150 lb. This figure is certainly high, and indicates that the efficiency of the electrical side has been sacrificed to the heating load, owing to the highly remunerative nature of the latter. The extent to which this is sometimes carried is exemplified by the regular practice of the Erie, Pa., combined station of dissipating electrical energy in a water load in order to obtain exhaust steam to turn into the heating mains. According to Mr. J. Fogarty, of the Erie Co., who has read a paper upon the subject before the Pennsylvania Electric Association, it is more economical to do this than to turn a proportion of live steam into the mains in order to maintain the pressure on a rising load.

Turning now to the street distribution system, upon the correct construction of which the success of a steam heating system largely depends, experience extending over something like 30 years has shown that low-pressure steam may be transmitted as much as 1½ miles with no appreciable drop of

pressure, and with a condensation loss of from less than ¼ per cent. to ¾ per cent. of the total steam delivered. Proof of this lies in the fact that many heating companies operate several miles of mains at station pressures as low as 1½ to 3 lb. per sq. in., although 5 lb. is the more usual pressure. Condensation loss is measured by installing traps and water meters at low points in the system of underground mains at distances of from 500 to 1,000 ft. As all services are taken off the top of the distributing pipes, no water of condensation is lost by being carried into the consumers' premises, and the method therefore gives correct results.

A good deal of ingenuity has been expended upon the design of underground mains and their lagging, particularly the latter. The changes have been rung upon asbestos, hair felt, mineral wool, magnesia sectional covering, cork covering, &c., as wrappings for the iron pipe, and all these have been tried in conjunction with conduits of brick, vitrified drain pipe, cement casing, boxing and round wood casing of

Fig. 2.

various thicknesses. Drain pipes and sectional earthenware conduit have been found unsatisfactory owing to their low heat-insulating value, and to difficulties with the joints. There are such a large number of these, and they are so easily broken by movement of the pipe when expanding or contracting, and also by settlement of the ground, which is almost sure to take place, that it is practically impossible to ensure the absolutely dry interior which is so essential. The broken cement joints allow water to find its way in, and soon the insulating material covering the steam pipe becomes thoroughly damp and loses all its value. Ultimately, it is dissolved or destroyed, and the pipe is left without insulation. Cement and brick conduits suffer from similar troubles and are not good heat insulators. In this respect a wooden covering is the best, but it must be of a special nature, calculated to withstand the onerous conditions obtaining underground. A

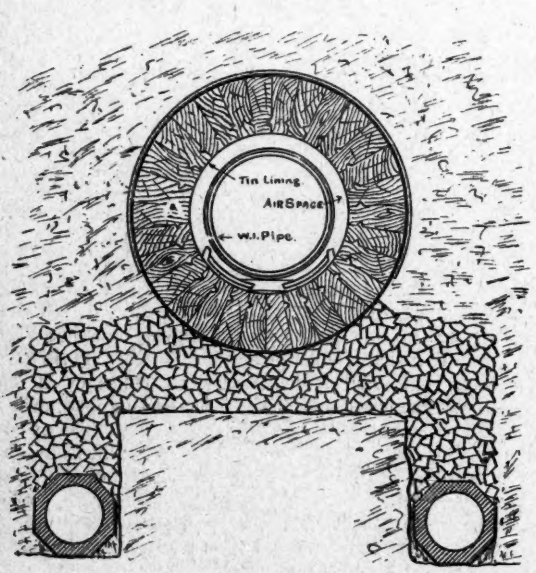


Fig. 3.

large number of American and Canadian installations have been laid down upon the system of the American District Steam Co., and the following details of their methods may be taken as representative of the best practice. The construction of the wooden casing employed is shown in fig. 2. It is built up of white pine staves free from sap, rot or shake, and air and kiln dried. The staves, which are 4 in. deep, are tongued and grooved along their entire length, and after being assembled, are placed in a banding machine, where they are bound together with a $\frac{3}{16}$-in. galvanised-steel wire, wound at a pressure sufficient to embed the wire into the wood and leave a smooth surface. The casing thus built up is supplied in various lengths not exceeding 8 ft., and each length has, as shown, a 4-in. mortice and tenon cut on its ends, the former being ½ in. greater in diameter than the latter to ensure a tight fit when the lengths are driven together. Each joint is treated with a creosote compound, and the outer surface of the casing is coated with asphalting pitch, and rolled in saw-dust. After being laid, a protection of three-ply tar paper is placed over the conduit, reaching on both sides to a point rather below the centre. An important point in this design of conduit is the interior tin lining, which is inserted after the staves are bound together. It consists of the best charcoal plate heavily tinned, and materially assists heat insulation by radiating back the heat given off by the pipe. It also protects the wooden casing from the effect of heat, and it is found in practice to retain its polished surface indefinitely. The circular form of this type of casing distributes the load from above proportionately to the various segments, and also prevents water forming in puddles to the detriment of the wood. The manner of joining up the sections gives adequate strength to resist the effect of ground subsidence, and for all practical purposes the conduit may be looked upon as continuous with no joints. The standard thickness of 4 in. was arrived at by tests to determine the thickness which would reduce condensation and transmission losses to a minimum, without increasing the cost of the casing beyond a comparable increase in efficiency.

Fig. 3 shows the manner in which the underground work is generally carried out. At the bottom of the trench a drainage system is installed, consisting of one or more lines of porous pipe not less than 3 in. in diameter, with open

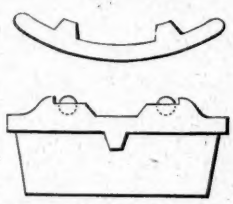


Fig. 4.

joints. These are properly graded and connected to the sewer as often as practicable, where necessary, through check valves. Next, a heavy course of broken stone, gravel or clean cinders is laid, and on this the casing is bedded, being threaded on to the iron steam-pipe length by length as the latter is installed. It will be seen from fig. 3 that there is a 1-in. air space between the pipes and the casing. Dead air space is one of the best of heat insulators, and loss by conduction arising from circulation of air through the casing is prevented by sealing the ends with metal collars at all possible points, such as junctions, &c. To allow of free movement of the steam pipe under expansion and contraction, it is carried and centred by guides and rollers placed in the casing about every 7 ft. The roller type is shown in fig. 3, and two others in fig. 4. Of these, the first is a plain guide used only with small pipes; the second provides a ball seat, the balls lying loose in and projecting above the edges of the two boxes formed in the top of the casting.

It is recommended that only wrought-iron pipe of good quality should be used for the steam main. This is flange jointed in the ordinary way, and after being laid in place is served with a covering of $\frac{1}{32}$-in. asbestos paper held in position by copper wire. Care in laying and grading is essential, and where natural conditions or obstructions cause low points in the mains, provision should be made for trap connections to handle the condensation. Expansion is a serious matter, and is met in the following way:—The pipe is laid in sections from 100 to 250 ft. long, and the centre of each section is firmly anchored by a special fitting placed on a brick or concrete foundation. Where the sections meet they are

joined up by a double expansion joint firmly anchored in the middle or stationary part, and it is at these points that necessary changes of grade or deviations from the straight are made. The joints have a traverse of from 3½ in. to 4 in. in each slip, which is more than sufficient to take care of the pipe movement. Expansion bends have been employed, but they are not satisfactory, being liable to break, and costing more to install owing to the extra amount of trenching and paving. Further, they tend to some extent to obstruct the flow of steam, and at the low pressures used this is an important point.

The plan of a typical street junction and valve box is shown in fig 5. It will be noticed that the ends of the wooden casing are blanked off by the collars previously referred to, and that the pipe itself is anchored at this point by long iron bars bolted to fittings and running along

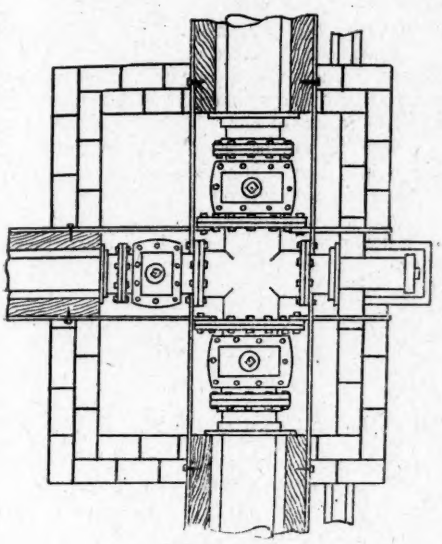


Fig. 5.

the casing, to which they are fastened by screws. The same course is pursued at all fittings, such as expansion joints, service connections, &c., unless provision has already been made in the form of a special anchorage in a concrete foundation.

Considerations of space forbid mention of numerous special and interesting fittings used in conjuction with the underground work, although it is upon these that satisfactory construction and freedom from trouble greatly depend. It remains only to deal with matters relating to the consumer, how he is charged and how his installation is arranged. Prior to the days of efficient meters, the only course open was to contract with each consumer on an agreed fixed charge per annum, and there are still several undertakings working upon these lines. It has, however, become recognised that the meter system is highly preferable and far more remunerative to the supplier, as it discourages waste. A contract rate is only applicable with safety to such buildings as offices where the hours of heating are clearly defined. Such rates may be based upon the total square feet of radiation in the building or upon its cubical contents, the latter being generally considered preferable. The charge varies from 1s. 3d. per sq. ft. upward for direct radiation per annum, and from 1s. 8d. per sq. ft. for indirect radiation, according to the locality and the cost of coal. Where the consumption is metered the charge is made at so much per 1,000 lb. of steam condensed. The rate, again, must vary with local conditions, but Mr. C. R. Bishop states that the average case will be met by a charge per 1,000 lb. of steam of approximately 10 per cent. of the cost to an individual user of 1 ton of anthracite coal, where that kind of fuel is in general use.

The condensation meter employed is simple in construction, the principle being that of a balance. On each side is a receptable holding a given weight of water, and when the uppermost one is full it falls and empties itself, the second vessel taking its place. The balance is connected to the dial through a train of wheels, and the number of pounds the meter discharges is thus registered.

Generally speaking, the condensed water is passed to the sewer, as in all but a small and compact area it does not pay to install the necessary return piping. Where used, this may with advantage be built of wood upon the same principle as the steam pipe casing minus the tin lining. Pipes of this class have a long life when used to convey water, and having excellent heat insulating properties save expense through requiring no lagging. Their walls are about 2 in. thick, and the several lengths are joined up by means of wooden thimbles fitting into sockets at the ends of the pipes.

No expansion or anchorage devices are used, and the whole construction is very simple.

RAILWAY RATES: OWNERS' RISK.

[communicated.]

The owners' risk question is an interesting one, and to describe it as a vexatious question would also be correct, as there is probably more litigation over these rates than over any other class of railway rates governed by the Railway Statutes. Railway Acts are usually difficult to understand, and the clause on the Owners' Risk Notes, which is, of course, governed by the Railway Act, is probably the most vague clause in all the laws pertaining to railways. To explain the matter properly it will be necessary to mention that the railway companies have two kinds of rates, viz. :—

1. One is the ordinary rate, when the railway takes the ordinary liability of a railway company.

2. The other class of rate is a reduced rate, adopted when the sender agrees to relieve the company and all the companies or persons concerned over whose lines the goods may pass, or in whose possession the goods may be during any portion of the transit, from all liability for loss, damage, misdelivery, delay or detention (including detention of traders' trucks) except upon proof that such loss, damage, misdelivery, delay or detention arose from *wilful misconduct* on the part of the company's servants.

Before the railway companies will agree to forward the traffic at the reduced rate, a form must be signed similarly worded to the second clause given above; this practically absolves the railway companies of all liability, unless the trader is fortunate enough to be able to adduce proof that the damage has been caused by the wilful misconduct of the railway company's servants. Seeing that the traders are unable to travel with the goods, it is seldom that they can prove their case. The agreement is evidently worded for the sole benefit of the railway companies, and unless goods are particularly liable to damage or loss, the railway companies take care that an owners' risk rate (at the reduced figure) is not put into operation, as, of course, it will pay the railway people, in the case of ordinary traffic, to take what slight risk there is in connection with such traffic, and charge the higher rate. On the other hand, should the traffic be either fragile or perishable, the railway companies are only too anxious to offer some slight inducement to the trader, so that the latter will take both the liability and the responsibility, and receive for doing so a reduction in the rate, which varies according to the class of goods and the price of rate charged. It often pays the traders to consign at the owners' risk rates, but one great defect in the matter is that the agreement is too one-sided, and the power of the railway companies with respect to these owners' risk rates should, to some extent, be curtailed. Although the railway companies are not compelled by law to make these rate concessions, they should not be allowed to make the bargain so that it prevents the trader from receiving fair treatment.

The railway companies must obtain a signed contract before they can legally compel the trader to adhere to the owners' risk conditions. Hence the reason why the owners' risk note has been introduced.

The existing law on the matter says :—

"Provided that no special contract between the companies and the parties respecting the receiving, forwarding and delivery of the goods, &c., shall be binding unless the same be signed by the person delivering such goods." Another interesting passage is :—"Nothing herein contained shall be construed to prevent the said companies from making such conditions with respect to the receiving, forwarding and delivery of goods, as shall be adjudged just and reasonable."

Seeing that the railway companies are not compelled to issue reduced rates, they are thus in the favourable position of practically being able to make, and also to enforce, their own terms, with the result that the conditions and terms of the present owners' risk notes are not as favourable to the trader as might be the case. Everything hinges on the term "wilful misconduct," and it is very difficult to prove that the railway people are to blame. However, it sometimes happens that the trader has eye-witnesses of the railway servant's carelessness, in which event the trader has a fair chance of winning the day.

The reader might ask the question : Why does the trader sign the owners' risk note when it is so disadvantageous to him when the goods are liable to damage ? The answer to the question is : That owing to the great disparity between the ordinary class of rate, and the reduced rate at owners' risk, it is better to take the risk than stand the loss of sale.

A custom prevalent over the railways in connection with owners' risk traffic is :—"When rates at owners' risks are provided for any article, both the 'owners' risk rate' and the 'company's risk rate' (whether for rates in the ordinary classes, or whether for special or exceptional rates) must be quoted. The higher rate must in all cases be quoted first, with the intimation that at that rate the railway company take the ordinary risk of a carrier ; but that, if the sender desires the goods to be carried at his risk, and will sign the prescribed form of risk note to that effect, the lower rate will be charged. The higher rate must be charged when the trader does not sign the risk note."

Many efforts have been made by the traders to amend and improve the owners' risk rate conditions (as witness the Bill, particulars of which are given hereafter), with, however, no result up to the present time, and it does not appear likely that the railway companies will willingly let go of their sheet-anchor clause "Wilful Misconduct," as they know very well that this term safeguards their interests as possibly no other term could do.

Time was when the restrictions and conditions in connection with the owners' risk scale of rates were not as rigidly enforced as they are to-day. In fact, a few years ago one could reasonably expect to get a claim for damage allowed, although the traffic travelled at owners' risk, and this claim was allowed without having to go to law. Now, owing to the Joint Claims Board being in operation, the railway companies have given the traders a nasty jar by withdrawing privileges and concessions which were in times gone by accepted by the trader as being usual.

The foregoing particulars describe the owners' risk question as it stands at the present time, and the examples hereunder show the difference between the ordinary rate and the owners' risk rate :—

Dynamos not packed : Ordinary rate, 45s. per ton ; owners' risk rate, 38s. 3d. per ton. The reduction in special rate varies from 10 to 20 per cent.

To amend the owners' risk rates, it is proposed to remedy matters by introducing a Bill into Parliament which will enable the trader to receive more equitable treatment.

An extract of the Bill is given hereunder :—

1. This act may be cited as the Railway and Canal Traffics Act, 1911, and shall be read with the Railway and Canal Traffic Acts, 1873 to 1894.

2. (i.) Every railway company and every canal company shall be deemed to be liable for the loss or deterioration of, and for any injury to, any goods, animals, or things in their custody or control which shall occur in the course of the receiving, forwarding, or delivery thereof by any such company, unless such company prove that such loss, deterioration or injury arose from some cause in respect of which the company is exempt from liability.

(ii.) The provisions of this section shall apply notwithstanding any notice, condition, or contract to the contrary.

3. It shall not be lawful for any railway company or canal company to make any conditions with respect to the receiving, forwarding, and delivery of traffic other than passengers and the luggage, whereby it is provided either expressly or by implication that the company shall not be liable for the loss of, or for any injury done to, or for the delay of such traffic, in the receiving, forwarding, or delivery thereof occasioned by the wilful default or misconduct of the company, or its servants.

8. In any action, suit or other legal proceedings of a civil nature (other than proceedings before the Railway and Canal Commissioners), which shall, after the passing of this Act, be brought by or against a railway company or a canal company, to enforce any claim in respect to the receiving, forwarding or delivery of goods, and wherein the amount in dispute shall not exceed £20, the decision of the Court in which such proceedings are taken shall be final and conclusive, and without appeal on any question, either of law or fact.

The proposals embodied in the Bill are both moderate and reasonable, and the Bill would certainly receive a good measure of support in the House of Commons ; in fact, it is said that over 100 members have already promised to support the measure.

To sum the matter up, the principal objects of the Bill are as follows :—

1. To do away with the existing "wilful" misconduct clause, which has been described earlier on.

2. To prevent the railway companies from taking cases from Court to Court, and so handicapping the smaller trader who has not the funds to combat a case in the High Courts.

In conclusion, it may be said that some revision in the owners' risk scale of rates is necessary, and it is to be hoped that all traders will give support to the aforementioned Bill, and by doing so assist in obtaining more equitable treatment from the railway companies. Finally, it may be mentioned that the railway companies not very long ago made some slight alterations in the Owner's Risk notes.

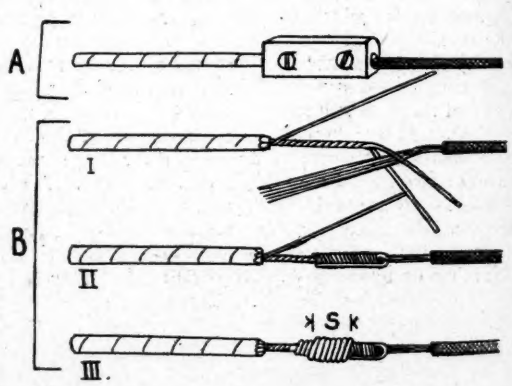
JOINTS FOR FLEXIBLES AND HARD WIRES.

By DONALD SMEATON MUNRO.

The Institution Wiring Rule No. 53 states that connections between flexibles and hard wires may be effected only by means of screw terminals in porcelain or other connecting boxes, or ceiling roses, *and not by soldering*.

The above rule is one which is frequently ignored in practice, and many have difficulty in seeing a good reason for such a definite and sweeping regulation.

The rule is invariably acted on in the case of a ceiling rose, and there few would quarrel with the terminal method of connection. The ceiling rose is perhaps the most generally suitable fitment for its purpose in the whole



range of common wiring accessories. It is cheap and easily fitted ; it is adapted for loop or single wiring ; it has provision for relieving the connection of stress, and the terminals are readily accessible at all times.

There are many situations, however, in which a ceiling rose cannot be used to connect hard wires to flexibles ; in practice these occur chiefly at bracket, ceiling fitting, and electrolier points, and in the interior of fittings.

In such places it is frequently exceedingly difficult to comply with the I.E.E. Rule, and whether the work is

intended to have a long and efficient life, or merely to have the quality of cheapness, then in either case an insulated joint is usually preferable to the ordinary forms of china connector. China connectors are always liable to breakage, and faulty threads on terminals are also frequent.

Those who advocate the use of connectors in preference to insulated joints have probably in view the workman who does not clean the wires properly, and uses acid flux for soldering. But such an incompetent workman is also likely to make defective junctions with china connectors.

Any prejudice which exists against joints between hard wires and flexibles has perhaps been intensified by the fact that there is no standard form of such joint. The small circuit hard wires to be connected to flexibles are generally 3/22 and 7/23 S.W.G. on modern work.

The writer asked several capable tradesmen to make up joints between flexibles and hard wires of the above sizes. He found a considerable variety of practice, but the most common form was some kind of end joint. That is to say, the joints were of Y form, the two upper arms of the Y being respectively the flexible and the hard wire, and the tail being formed by the combined twisted ends; the method of twisting was ingeniously varied. This kind of joint, however, while occupying little space, has no great tensile strength, and is difficult to insulate neatly.

The writer considers that the joint shown in illustration B is probably as good a form as can be devised. In the sketch a 3/22 wire is shown jointed to a piece of flexible. The three strands are separated and cleaned, then two are twisted together for more than half their length, the ends being forked, as shown in (I B). The flexible is then inserted into the fork and twisted in one direction around the pair of wires; the two forked ends are then bent up, and the whole is neatly bound with the third strand of the 3/22 wire. The joint is then pulled straight and tight and soldered on the section S indicated in (III B). The result is a strong connection with no sharp edges or ends, and the flexible is free to bend readily in any desired direction.

A large number of different samples of joints were tested against a spring. These were made up of 3/22 S.W.G. and 35/40 flexible. Joints, as described above, fractured on the average at 35 lb. pull. End joints gave way at 20 lb., and china connectors of the common form, as in sketch (A), ruptured at only 8 lb. pull.

The strength of flexible is very materially reduced by the strands being bound under the connector terminal. Some of the strands are nipped by the point of the pinching screw, and a very slight pull is sufficient to produce a long, irregular break, with loose springy ends, liable to make harmful contacts.

Some of the defects of the china connector would be obviated if the brass parts were tinned, and if the connector itself were finally insulated, to guard against surface leakage caused by condensation and damp air; but many types of connector are difficult to insulate, and the practice is uncommon.

The above-mentioned tensile tests were taken when the junctions were bare, and would be still more favourable to the soldered joints, if taken in their final insulated condition.

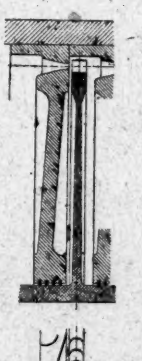


FIG. 3.—SINGLE STAGE OF IMPULSE TURBINE AND SECTION OF BLADING.

The same principle is, of course, followed in making joints between flexible and seven-strand wires. In this case, however, four strands are twisted together and forked two on either side for the reception of the flexible, the joint being finally bound with the remaining three strands.

PROCEEDINGS OF INSTITUTIONS.

Steam Turbines.

By H. ZOELLY, of Zurich.

(*Abstract of paper read at the Zürich meeting of the* INSTITUTION OF MECHANICAL ENGINEERS., *July, 1911.*)

RELYING chiefly upon his experience gained with water turbines, the author commenced about 15 years ago to experiment with steam turbines, considering that the steam turbine would resemble in most respects the water turbine, only using a much higher working pressure. For this reason he adopted the pure action or impulse type of steam turbine.

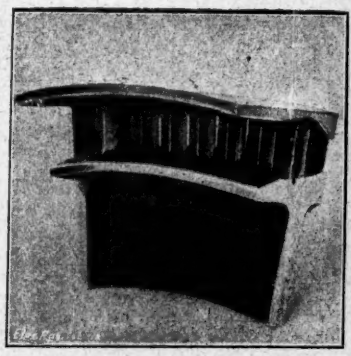


FIG. 1.—GUIDE CHANNELS IN DIAPHRAGM PLATE.

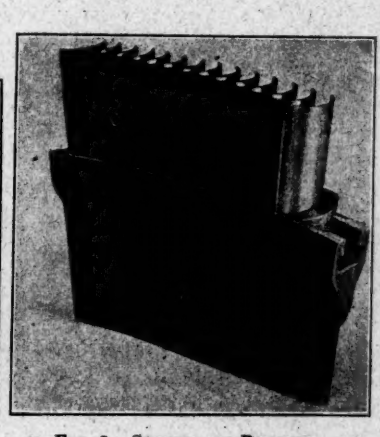


FIG. 2.—SECTION OF RUNNER WHEEL.

The most characteristic feature of the Zoelly turbine is the designing of the runner wheels and the guide channels in the diaphragms, figs. 1 and 2, the former of which, in spite of the high factor of safety that is necessary, are enabled to be given a relatively high circumferential velocity. Consequently greater latitude is permissible in regard to the number of pressure stages and the speed of the steam in each.

The pressure relation per stage $\frac{p\,1}{p\,2}$ (where $p\,1$ = the initial steam pressure and $p\,2$ = the final steam pressure in atmospheres absolute in the same stage) = 1·73 was chosen as representing the best combination of efficiency and practical constructional economy. Directly one wishes to utilise a substantially higher pressure fall per stage, it becomes necessary to depart from the simple construction of parallel guide nozzles which is peculiar to the Zoelly

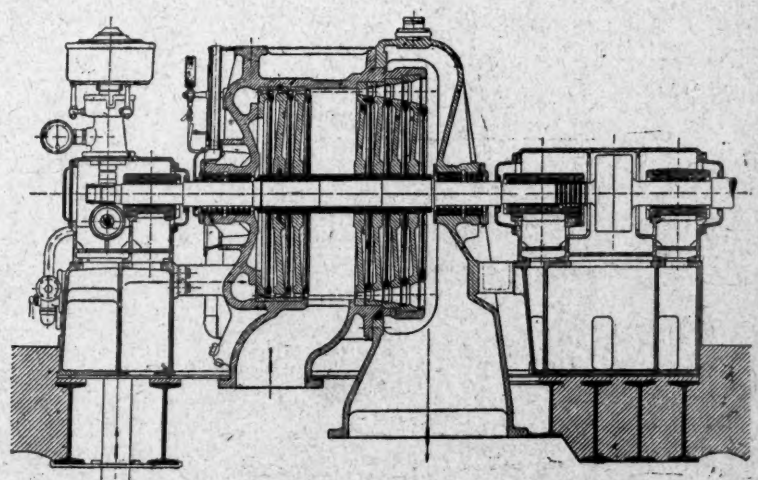


FIG. 4.—1,800-H.P. MIXED-PRESSURE TURBINE FOR "ZECHE DANNENBAUM" (ZOELLY), 3,000 R.P.M.

turbine, so that, instead of the simple parallel nozzle, one must adopt the expanding or "Laval" type of nozzle. The reason that Parsons employs such a small pressure fall per stage is entirely to keep down as low as possible the losses through leakage which are unavoidable in reaction turbines.

The author describes the Zoelly turbine as manufactured at the present time by Messrs. Escher, Wyss & Co. For turbines of 3,000 R.P.M. eight stages are usually employed; for 1,500 R.P.M. 12 stages; and for 1,000 R.P.M., 16 stages.

The first diaphragm plate (guide wheel) of the high-speed turbines has nozzles which extend for a portion of the circumference only in the bottom half of the diaphragms; whilst in the other diaphragms, the nozzles usually extend completely round the

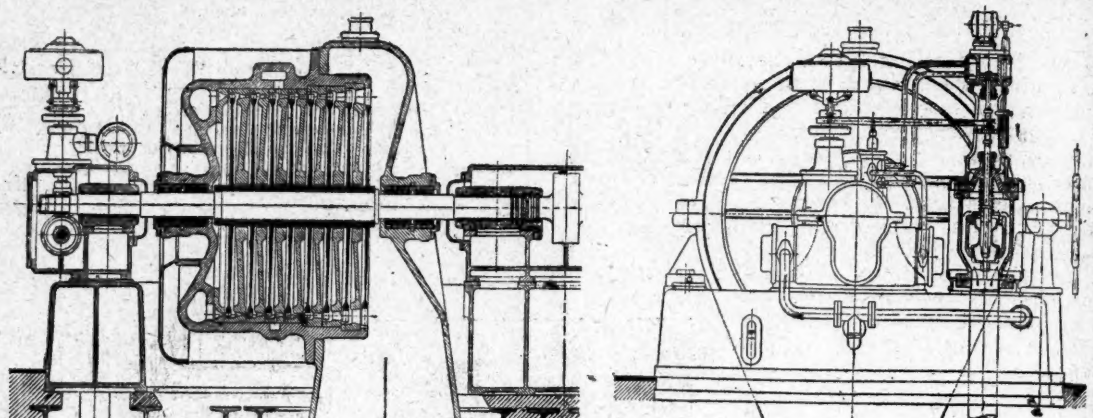


FIG. 5.—1,500-1,800-H.P. EIGHT-STAGE ZOELLY STEAM TURBINE, 3,000 R.P.M.

circumference. In the case of large units, however, steam is admitted through channels extending completely round the circumference for all stages.

The governing is effected simply by throttling the live steam and not by varying the number of channels through which the steam is admitted. The throttle-valve is actuated by oil under pressure in a small cylinder (servo-motor) by hydraulic action, the oil being supplied by a small pump directly driven from the shaft.

This is the same form of governing as that which has been found to work so successfully for water-turbines, and is now being universally adopted by nearly all the different makers of steam turbines on the Continent. Its inherent advantages are, that it is extremely simple and reliable, and, contrary to fears expressed by some engineers, this method of governing works particularly economically at partial loads, as is seen from the results shown

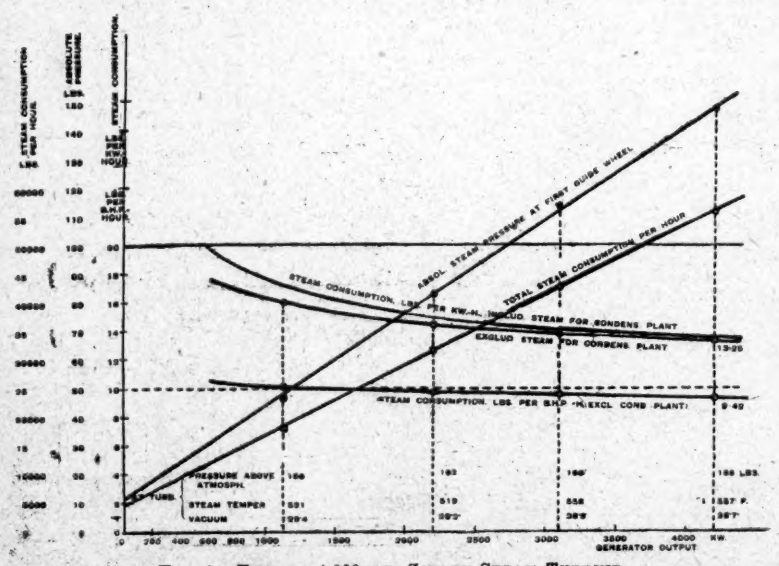

STEAM CONSUMPTION PER HOUR
ABSOL. STEAM PRESSURE AT FIRST GUIDE WHEEL
STEAM CONSUMPTION, LBS. PER KW.-H. INCLUD. STEAM FOR CONDENS PLANT
TOTAL STEAM CONSUMPTION PER HOUR
EXCLUD STEAM FOR CONDENS PLANT
STEAM CONSUMPTION, LBS. PER B.H.P. (EXCL COND PLANT)
PRESSURE ABOVE ATMOSPH.
STEAM TEMPER
VACUUM
GENERATOR OUTPUT

FIG. 6.—TEST OF 4,000-KW. ZOELLY STEAM TURBINE.

later. This, however, is only possible when simple velocity wheels are used in connection with parallel guide-nozzles throughout the whole turbine, and provided that the most favourable choice is made in regard to the sub-division of stages. Fig. 3 illustrates a simple velocity stage in a Zoelly turbine, showing section of blading. The conclusion arrived at is that the compound velocity wheel design is only advisable in special cases, as, for instance, in ship-building, where a lower propeller speed is absolutely necessary.

The chief reasons against the adoption of the compound wheel design in the case of stationary turbines are the lower steam efficiency and the necessity of a complicated governing apparatus, in order to obtain a favourable consumption at partial loads. In this type of turbine the governing has to be carried out by controlling the number of nozzles through which the steam enters. Experience has shown that this method does not satisfactorily answer practical requirements, *i.e.*, continuous safe running. Besides, the governing is not so accurate, and is less suitable for running in parallel with other machines.

The author for many years has experimented with turbines designed with a high steam velocity and compound wheels. The many series of tests which he has carried out at different periods have all gone to show that under the most favourable conditions it is not possible to obtain a higher thermal efficiency with compound velocity wheels than 58 per cent., whereas with a turbine designed with entirely simple velocity stages it is possible to obtain an efficiency of 73 per cent. and more. If, therefore, in an impulse turbine it is found necessary to employ a combination design of compound and single velocity stages for such special cases as exceptionally large units for land purposes, or where it is necessary to work at low revolutions, the comparatively poor efficiency of the high-pressure compound velocity stage or stages must be compensated for as well as is possible by obtaining a relatively higher efficiency in the subsequent low-pressure single velocity stages. For this purpose almost as many pressure stages must, on the whole, be provided for as in a design employing only single velocity stages.

It is often objected to in the Zoelly turbines that too high a pressure and temperature exist in the first pressure stage; against this it must be said that even with Zoelly turbines likewise large pressure-falls can be utilised for the first stage within comparatively economical limits, provided that the lower pressure or subsequent stages have a correspondingly lower pressure-fall and consequently work with a higher efficiency.

The Zoelly turbine has from the commencement always been constructed with a horizontal shaft; experience with water-turbines has shown that by this method the simplest form of bearing can be used, permitting easy inspection at all times.

In the case of turbines running at 3,000 R.P.M., a flexible shaft is used, so that the critical speed is sufficiently below the working speed; but in the case of turbines running at 1,500 R.P.M. and under, the contrary is the case, the shaft is rigid and the critical speed is above the working speed. The shaft is supported by two bearings which are lubricated by oil under pressure, and is connected by means of a rigid or flexible coupling (usually rigid) to the generator or machine to be driven. The casing is built up in two halves, the joint being horizontal, so that the rotor can easily be inspected without dismantling the bearings. An idea of the accessibility of all the important parts can be gained from the illustrations shown.

Actual results, obtained on trials (see table) by means of specially tested instruments and by impartial officials show the high economy that is obtained by this turbine, particularly at partial loads.

Fig. 5 shows to scale a section of a normal eight-stage Zoelly steam turbine constructed to develop 1,500 to 1,800 H.P. at 3,000 R.P.M., with a steam pressure of 170 lb. per sq. in. at 570° F. (300° C.) and with a vacuum of 95 per cent.

Fig. 4 shows to scale a section of a mixed-pressure Zoelly steam-turbine constructed for "Zeche, Dannenbaum," to develop 1,800 H.P. at 3,000 R.P.M. with a main steam-pressure of 115 to 120 lb. per sq. in., using exhaust steam at a pressure varying

from 5 lb. to 12 lb. per sq. in. and with a vacuum of 91 per cent. During the same period that the previously referred to experiments were being carried out, tests were in hand with a view to perfecting a design of slow-running turbine suitable for ship propulsion. The high-pressure portion of these marine turbines is fitted with a series of compound velocity wheels. The low-pressure portion consists of impulse drum blading. Messrs. Escher, Wyss and Co. recently built a set of two marine turbines, each of 7,500 H.P., which are now in operation in a torpedo-boat destroyer of the Imperial German navy.

SOME TEST RESULTS OBTAINED WITH ZOELLY STEAM TURBINES; NOVEMBER AND DECEMBER, 1910.

Installation.	Load in KW.	Steam pressure at stop valve.		Vacuum.	Steam consumption.		Thermal efficiency, per cent.	
		Lb. per sq. in.	Temp. °F.		KW.-hour.	H.P.-hour.	Based on condition of steam. In front of stop valve.	Behind stop valve.
				%	Lb.	Lb.	%	%
4,000-KW. turbine 1,000 R.P.M. (See fig. 6)	4,189	164·7	556·7	95·8	*13·25	9·36	68·7	71·2
	3,092	168·3	558·3	96·2	13·77	9·58	66·2	70·8
	2,199	161·9	518·5	97·4	14·40	9·84	63·2	70·75
	1,138	166·9	520·7	97·8	16·00	10·12	59·9	72·7
2,000-KW. turbine 3,000 R.P.M.	2,052	179·0	584·6	94·9	13·04	9·18	70·5	73·0
	1,514	181·7	563·3	95·5	13·67	9·52	67·2	72·8
	1,026	177·5	565·5	95·8	14·53	9·76	65·2	73·8
	510	171·8	543·0	96·6	17·33	10·68	58·8	72·8
1,700-KW. turbine 3,000 R.P.M.	1,691	206·0	670·2	93·3	13·04	8·91	69·7	69·8
	1,366	202·3	673·5	94·2	13·77	9·18	66·5	69·2
	851	205·2	662·0	95·2	15·52	9·81	61·0	66·9
	457·5	208·0	642·9	94·9	18·91	10·68	57·1	67·9
1,200-KW. turbine 3,000 R.P.M.	—	—	—	—	—	—	—	—
	1,235	162·3	451·0	94·0	15·34	10·77	67·0	68·3
	949	164·0	442·4	95·5	15·99	11·08	62·8	66·9
	606	166·7	427·4	96·5	17·1	11·48	59·0	66·6

* Not including steam required for condensing plant.

We give in fig. 6 a diagram of the characteristics of the 4,000-KW. Zoelly steam turbine running at 1,000 R.P.M. as built by Messrs. Escher, Wyss & Co., for 165 lb. per sq. in. steam pressure. This diagram does not appear along with the paper read by Mr. Zoelly at the Zurich meeting, and the additional information which it gives will be of interest to our readers.

TRADE STATISTICS OF ROUMANIA.

THE following statement, showing the imports of electrical and similar goods into Roumania in 1909, is taken from the official trade statistics which have recently been issued; the figures for 1908 are added for purposes of comparison and notes of any increases or decreases are given :—

	1908. Kilogs.	1909. Kilogs.	Increase or decrease. Kilogs.
Electric insulators of faience and porcelain even combined with other materials.—			
From Austria	52,000	32,000	— 20,000
,, Germany.	88,000	37,000	— 51,000
,, Italy	24,000	—	— 24,000
,, Other countries ...	1,000	1,000	—
Total ...	165,000	70,000	— 95,000
Boilers.—			
From Great Britain ...	13,000	2,000	— 11,000
,, Austria	22,000	92,000	+ 70,000
,, France	27,000	30,000	+ 3,000
,, Germany	266,000	179,000	— 87,000
,, Other countries ...	1,000	20,000	+ 19,000
Total ...	329,000	323,000	— 6,000
Iron wire, galvanised, &c.—			
From Great Britain ...	356,000	62,000	—294,000
,, Austria	116,000	51,000	— 65,000
,, Belgium	51,000	15,000	— 36,000
,, France	—	2,000	+ 2,000
,, Germany	442,000	261,000	—181,000
,, Holland	21,000	86,000	+ 65,000
,, Other countries ...	—	1,000	+ 1,000
Total ...	986,000	478,000	—508,000
Electric incandescent lamps.—			
From Austria	4,000	5,000	+ 1,000
,, Germany	10,000	13,000	+ 3,000
,, Other countries ...	1,000	—	— 1,000
Total ...	15,000	18,000	+ 3,000
Copper wire.—			
From Great Britain ...	2,000	—	— 2,000
,, Austria	22,000	20,000	— 2,000
,, Germany	129,000	104,000	— 25,000
,, Other countries ...	6,000	3,000	— 3,000
Total ...	159,000	127,000	— 32,000
Steam engines.—			
From Great Britain ...	241,000	30,000	—211,000
,, Austria	859,000	129,000	—730,000
,, Germany	1,105,000	1,415,000	+310,000
,, Russia	602,000	—	—602,000
,, Other countries ...	161,000	64,000	— 97,000
Total ...	2,968,000	1,638,000	—1,330,000
Petroleum engines.—			
From Great Britain ...	227,000	932,000	+705,000
,, Austria	259,000	475,000	+216,000
,, Germany	1,372,000	1,462,000	+ 90,000
,, Switzerland ...	164,000	237,000	+ 73,000
,, Other countries ...	24,000	135,000	+111,000
Total ...	2,046,000	3,241,000	+1,195,000
Gas, compressed air, &c., engines.—			
From Great Britain ...	29,000	45,000	+ 16,000
,, Austria	56,000	85,000	+ 29,000
,, Germany	133,000	343,000	+210,000
,, Switzerland ...	11,000	58,000	+ 47,000
Total ...	229,000	531,000	+302,000
Dynamo-electric machines, electric motors, converters, transformers, &c.—			
From Great Britain ...	1,000	2,000	+ 1,000
,, Austria	108,000	22,000	— 86,000
,, Belgium	151,000	15,000	—136,000
,, France	3,000	1,000	— 2,000
,, Germany	739,000	557,000	—188,000
,, Other countries ...	13,000	16,000	+ 3,000
Total ...	1,015,000	613,000	—402,000
Accumulators and spare plates.—			
From Great Britain ...	1,000	—	— 1,000
,, Austria	96,000	133,000	+ 37,000
,, France	1,000	1,000	—
,, Germany	81,000	34,000	— 47,000
,, Other countries ...	7,000	—	— 7,000
Total ...	186,000	168,000	— 18,000
Arc lamps.—			
From Austria	1,000	1,000	—
,, Germany	9,000	13,000	+ 4,000
,, Other countries ...	—	1,000	+ 1,000
Total ...	10,000	15,000	+ 5,000
Electric apparatus for telegraphs and telephones.—			
From Austria	4,000	1,000	— 3,000
,, Germany	30,000	15,000	— 15,000
,, Other countries ...	7,000	7,000	—
Total ...	41,000	23,000	— 18,000
Ditto for transmission of power and light.—			
From Austria	2,000	1,000	— 1,000
,, Germany	17,000	12,000	— 5,000
,, Other countries ...	1,000	2,000	+ 1,000
Total ...	20,000	15,000	— 5,000
Interrupters, &c.—			
From Austria	7,000	7,000	—
,, Germany	66,000	63,000	— 3,000
,, Other countries ...	2,000	1,000	— 1,000
Total ...	75,000	71,000	— 4,000
Cables for transmission of electricity and insulated wire.—			
From Great Britain ...	—	27,000	+ 27,000
,, Austria	29,000	18,000	— 11,000
,, Germany	877,000	342,000	—535,000
,, Other countries ...	1,000	3,000	+ 2,000
Total ...	907,000	390,000	—517,000

NEW PATENTS APPLIED FOR, 1911.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

18,745. "Safety brake mechanism for tramcars and the like." E. L. Wilson. August 21st.

18,759. "Electrical method of obtaining variable speeds between a driving and a driven shaft, specially suitable for the transmission gear of motor vehicles." P. L. Raeburn Fraser. August 21st.

18,763. "Meter-testing cut-out." T. E. Murray. (Convention date, October 25th, 1910, United States.) August 21st. (Complete.)

18,778. "Electric push-button switch." J. Brunner. August 21st. (Complete.)

18,785. "Antiseptic telephone mouthpieces." W. M. English, L. E. Boukofsky and S. M. Lichtenstein. (Convention date, August 29th, 1910, United States.) August 21st. (Complete.)

18,793. "Lead oxide agglutinant for increasing the strength and the porosity of the active material of the plates of secondary batteries." P. Marino. August 21st.

18,804. "Furnaces for the production of metallic sodium by electrolysis." E. Scheitlin. (Convention date, August 20th, 1910, Germany.) August 21st. (Complete.)

18,852. "Arc lamps." I. Levy and F. Shepherd. August 22nd.

18,868. "Boosting transformers, voltage regulators, and the like." Siemens-Schuckertwerke G.m.b.H. (Convention date, August 22nd, 1910, Germany.) August 22nd. (Complete.)

18,879. "Wireless telegraphy apparatus." C. Wirth, C. Beck and H. Krauss. August 22nd. (Complete.)

18,881. "Tumbler switches." W. E. Lake. (Geb. Jaeger, Germany.) August 22nd. (Complete.)

18,898. "Electric traction systems." British Thomson-Houston Co., Ltd. (Allgemeine Elektricitäts, Ges., Germany.) August 22nd.

18,901. "Certain kinds of fittings for electrical conduits." J. W. Brooks (trading as) Walsall Hardware Manufacturing Co., and A. E. Read. August 23rd.

18,906. "Electric lampholders." F. Booth and N. R. Booth. August 23rd.

18,908. "Electrical conductors." B. A. Pilkington. August 23rd.

18,911. "Driving-gear of electrically-operated winches." D. Wilson. August 23rd. (Complete.)

18,925. "Multiple arc lamps." J. Wetter. (Ges. fur Maschinen-und Metall-Industrie m.b.H., Germany.) August 23rd. (Complete.)

18,949. "Wire-covering machines." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) August 23rd.

18,976. "Electrical means for igniting gas lamps." R. Hacking. August 24th.

18,981. "Apparatus for testing sparking plugs in internal-combustion engines." W. H. Story. August 24th.

18,997. "Electrostatic valves." O. Steels. August 24th. (Complete.)

18,998. "System of underground electric dispatch for mail and parcels." K. E. Stuart. (Convention date, September 9th, 1910, United States.) August 24th. (Complete.)

19,002. "Electric arc lamps." Ges. fur Maschinen und Metall-Industrie m.b.H. (Convention date, August 31st, 1910, Germany.) August 24th. (Complete.)

19,011. "Telephones." B. Gwozdz. (Addition to 11,284 of 1911; Convention date, June 17th, 1911, Germany.) August 24th. (Complete.)

19,026. "Magneto ignition for internal combustion engines." J. E. F. Cambessedes. (Addition to 13,633/11. Convention date, August 24th, 1910, Belgium.) August 24th. (Complete.)

19,034. "Electric horns." H. Lucas and W. H. Edwards. August 24th.

19,035. "Electric horns." H. Lucas and W. H. Edwards. August 24th.

19,047. "Methods and apparatus for shaping filaments for electric lamps and the like." R. W. Suman. (Convention date, May 31st, 1911, U.S.) August 24th. (Complete.)

19,062. "Adjustable insulator and clip for electric conductors." H. P. Allin and J. M. Allin. August 25th.

19,064. "Surface conduit system for electric railways." H. P. Allin and J. M. Allin. August 25th.

19,065. "Telegraph instruments." British Insulated and Helsby Cables, Ltd., and G. W. Moore. August 25th.

19,069. "Magnetic emanation." H. Harris. August 25th.

19,083. "Regulators for electrically-driven ring spinning and doubling machines." Siemens Bros. Dynamo Works, Ltd., and E. O. Kiefer. August 25th.

19,084. "Regulators for electrically-driven ring spinning and doubling machines." Siemens Bros. Dynamo Works, Ltd., J. F. Crowley and S. Gowan. August 25th.

19,085. "Regulators for electrically-driven ring spinning and doubling machines." Siemens Bros. Dynamo Works, Ltd., J. F. Crowley and S. Gowan. August 25th.

19,092. "Electrolytic refining of copper." S. O. Cowper-Coles. August 25th.

19,093. "Electro-deposition of copper." S. O. Cowper-Coles. August 25th.

19,097. "Electrical braking mechanism." K. Brull. August 25th.

19,108. "Electric heating devices." British Thomson-Houston Co., Ltd. (General Electric Co., United States). August 25th.

19,109. "Electric lamps." British Thomson-Houston Co., Ltd., and H. H. Needham. August 25th.

19,114. "Submarine telegraphy." S. G. Brown. August 25th.

19,116. "Manufacture of electrical coils." W. E. Lake. (Weston Electrical Instrument Co., United States.) (Divided application on 9,000/11, April 11th.) (Complete.)

19,120. "Cut-out or fuse." N. Santo. (Convention date, August 25th, 1910, France.) August 25th. (Complete.)

19,160. "Machines for generating electricity and machines driven by electricity." R. Boyd. August 26th.

19,162. "Electric drive for machine tools." J. Fryer. August 26th. (Complete.)

19,182. "Electric lampholders." H. Lucas and F. Jenkins. August 26th.

19,185. "Circuit arrangements for automatic telephone exchanges." Siemens & Halske Akt.-Ges. (Convention date, August 27th, 1910, Germany.) August 26th. (Complete.)

19,186. "Circuit arrangements for automatic telephone systems." Siemens and Halske Akt.-Ges. (Convention date, August 27th, 1910, Germany.) August 26th. (Complete.)

19,187. "Circuit arrangements for automatic telephone systems." Siemens and Halske Akt.-Ges. (Convention date, August 27th, 1910, Germany.) August 26th. (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of Messrs. W. P. Thompson & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1910.

Joint-Boxes for Electric Wiring. A. Friedmann. 12,931. May 27th. (December 1st, 1910.)

Electric Lighting for Vehicles. E. Gabreau. 18,035. May 28th.

Controllers for Electric Motors. Adams Mfg. Co. (Cutler-Hammer Mfg. Co.) 18,190. July 30th.

Apparatus for the Electrolysis of Fused Alkali Chlorides. Ges Fur Chemische Industrie in Basel. 18,800. August 2nd. (December 22nd, 1909.)

Means for Controlling Dynamo-Electric Machines. Adams Mfg. Co. (Cutler-Hammer Mfg. Co.) 18,806. August 2nd.

Propulsion of Vehicles by Combination of Prime Mover and Electrical Storage. F. W. Lanchester. 18,631. August 8th.

Flexible-Cord Attachment for Electric Lamp Holders. C. A. M. Renton. 18,655. August 8th.

Utilisation of the Silent Electric Discharge. E. N. Rideal. 18,680. August 8th.

Electric Time-Alarm Device. A. Girardelli and P. Holzman. 20,696. September 5th.

Combined Electric Switch and Fuse Distribution Boxes for use with Electric Cranes. Electric and Ordnance Accessories Co. and M. R. H. Mueller. 20,995. September 8th.

Electric Portable Lamps for use in Mines and other places. W. E. Gray. 21,060. September 10th.

Electric Meters. British Thomson-Houston Co. and H. J. Martin. 23,066. October 5th.

Method of Supporting Electric Cables or Wires, and means therefor. Bullers, Ltd., and H. Dagnall. 23,153. October 6th.

Process of Treating Aluminium Articles for the Formation thereupon of Galvanic Metallic Coatings. C. Rumpler. 23,359. October 8th.

Sparking Plugs for Internal-Combustion Engines. A. E. Fletcher and A. E. Dale. 23,807. October 14th.

Electric Heating-Irons. H. Hirst and C. H. Archer. 23,902. October 15th. (November 1st, 1910.)

Electrical Resistances. M. B. Field and Ferranti, Ltd. 24,485. October 21st.

Submarine Audible Telegraphy and Signalling. E. Klupathy and C. Berger. 27,144. November 22nd. (July 30th, 1910.)

Electrical Insulators for use in Mines. C. W. Speakman. 27,804. November 29th. (November 29th, 1909.)

Electric Furnaces. V. Popp. 30,390. December 31st. (May 6th, 1910.)

1911.

Portable Electric Lamps. A. Lobel and British Ever-Ready Electrical Co. 9,050. April 11th.

Electrodes for Electric Furnaces. O. Imray. (Shawinigan Carbide Co.) 9,658. April 20th.

Production of Quenched Electrical Spark Discharges. R. Galletti. 10,639. May 2nd. (May 3rd, 1910.)

Alternating-Current Block Circuits for Railway Signalling. Siemens Bros. & Co. (Siemens & Halske Akt.-Ges.) 10,884. May 4th.

Electric Hammers. H. F. Whalton. 12,742. May 26th. (May 26th, 1910.)

Switchgear for Overhead Railway. W. G. Webb, W. G. Brettell and Adamson. 279. January 4th.

Electric Tightening Devices for Cable Conveyors. H. O. Adam. 1,909. January 25th. (January 26th, 1910.)

Device for Continually Rolling About a Number of Articles by means of Endless Bands for Electrical or Mechanical Treatment. K. Ochs. 4,724. February 24th.

Construction of Electromagnets for Indicators, Relays and Similar Apparatus. E. A. Parkes. 4,806. February 25th.

Insulating Material. British Thomson-Houston Co. (General Electric Co.) 5,167. March 1st.

Electric Ignition Device for Gas-Burners. W. Wasserzier. 6,182. March 11th.

Arc Lamps. Siemens-Schuckertwerke Ges. 7,501. March 25th. (March 26th, 1910.)

Control Systems for Alternating-Current Electric Motors. L. W. Lewis. 8,783. April 8th.

Electricity Meters. Chamberlain & Hookham, Ltd., and S. H. Holden. 10,080. April 26th.

Electric Shutter Indicators. J. Zickel. 10,545. May 1st. (May 2nd, 1910. Addition to No. 26,502 of 1908.)

Semi-Automatic Telephone Exchange Systems. Siemens Bros. & Co. (Siemens & Halske Akt.-Ges.) 12,117. May 19th.

Automatic Regulators for Electric Circuits. Siemens-Schuckertwerke Ges. 14,432. June 17th. (June 17th, 1910.)

Hydro-Electric Works.—It is announced from Buda-Pesth that Ganz & Co. have been entrusted with the contract for the carrying out of a large power transmission works for the Company for the Utilisation of the Hydraulic Powers in Dalmatia of Trieste. The Hungarian firm has previously equipped for the same company a transmission plant of 32,000 H.P. by the use of the water-power of the Kerka river near Jaruga and Manojlovac, the power being employed for the operation of the carbide works at Sebenico. The new installation proposes the utilisation of the water-power of the Cetina river in the neighbourhood of Almissa, the available power exceeding 200,000 H.P. It is, however, intended only to make use of 40,000 H.P. as a first instalment. The works will be provided with two units each of 20,000 H.P., and two rotary current transformers of 18,000 H.P. will be arranged in the station, and two of the same power at the end of the transmission line, for raising and reducing the voltage respectively. The transmission will be effected at 55,000 volts over a distance of nearly 16 miles. It is claimed that the generators will be the largest so far constructed in Europe, and that the hydraulic turbines and the transformers will be the largest in the world. The firm of Ganz and Co.-Danubius, will undertake the hydraulic portion of the work as represented by turbines, pipes and sluices.